TECHNOLOGY REVIEW

December 195

Vol 59 #2
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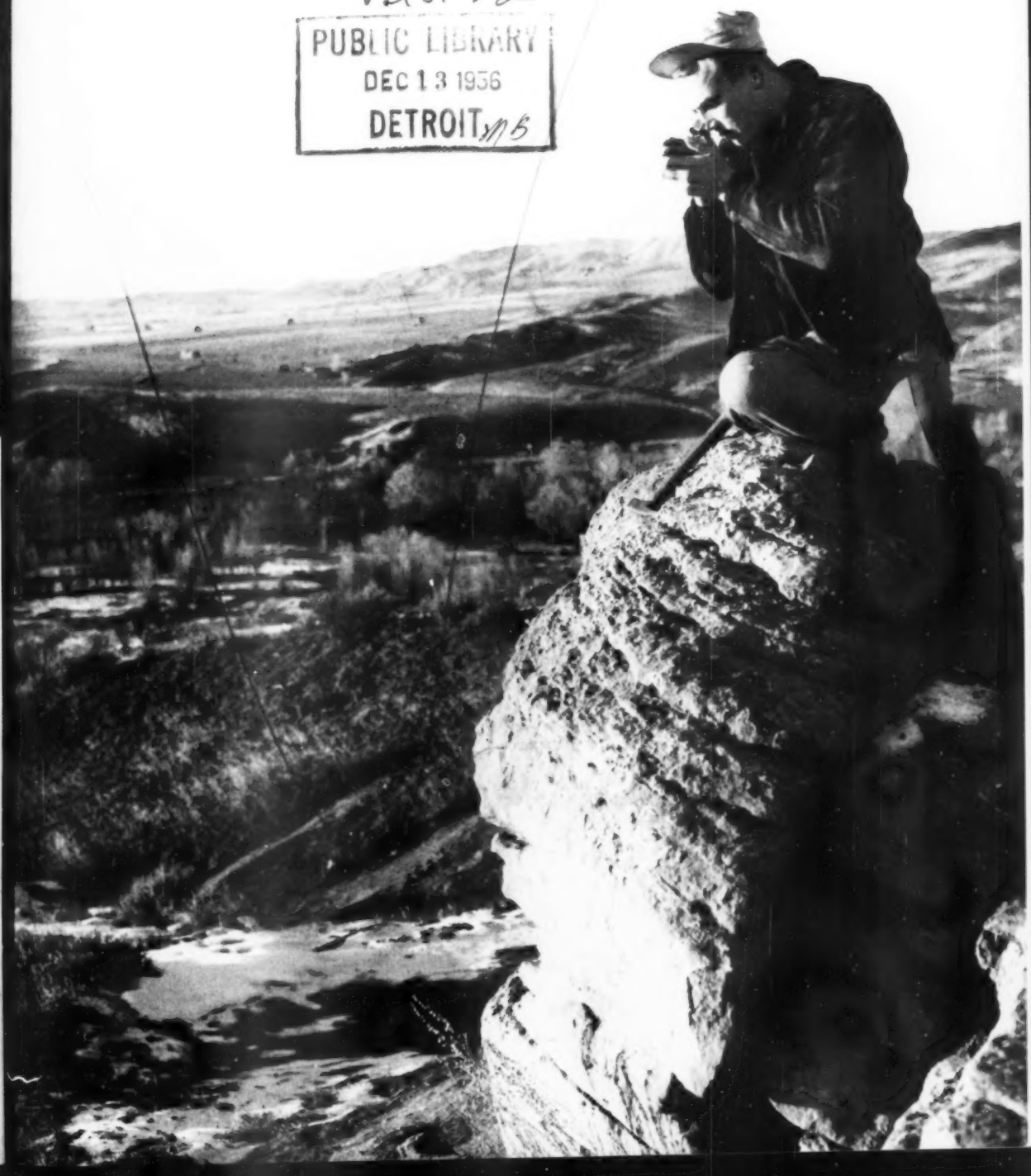

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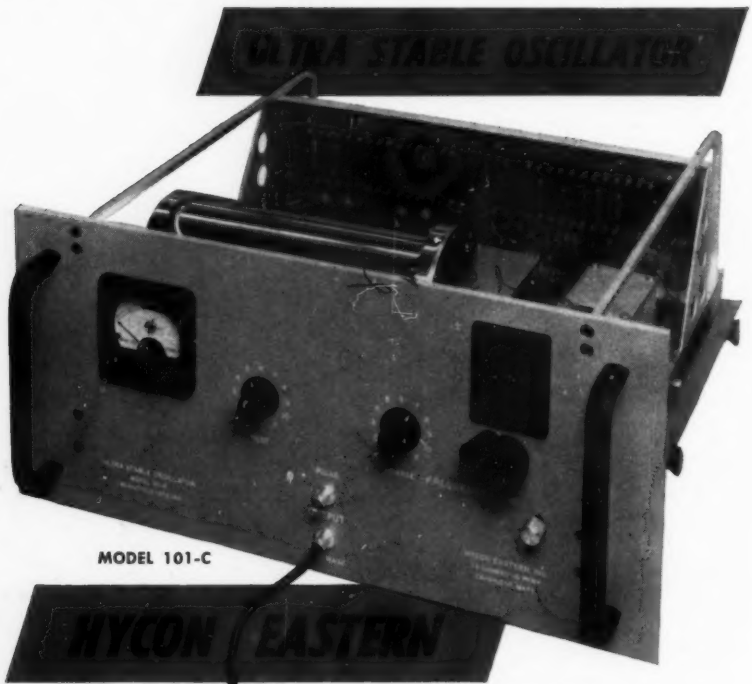

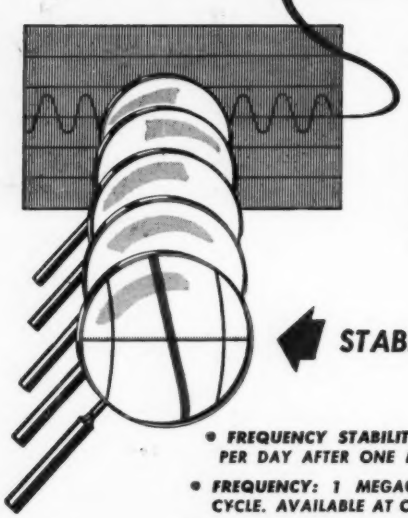

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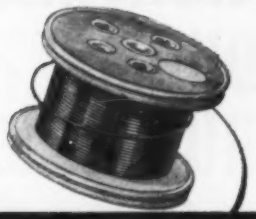

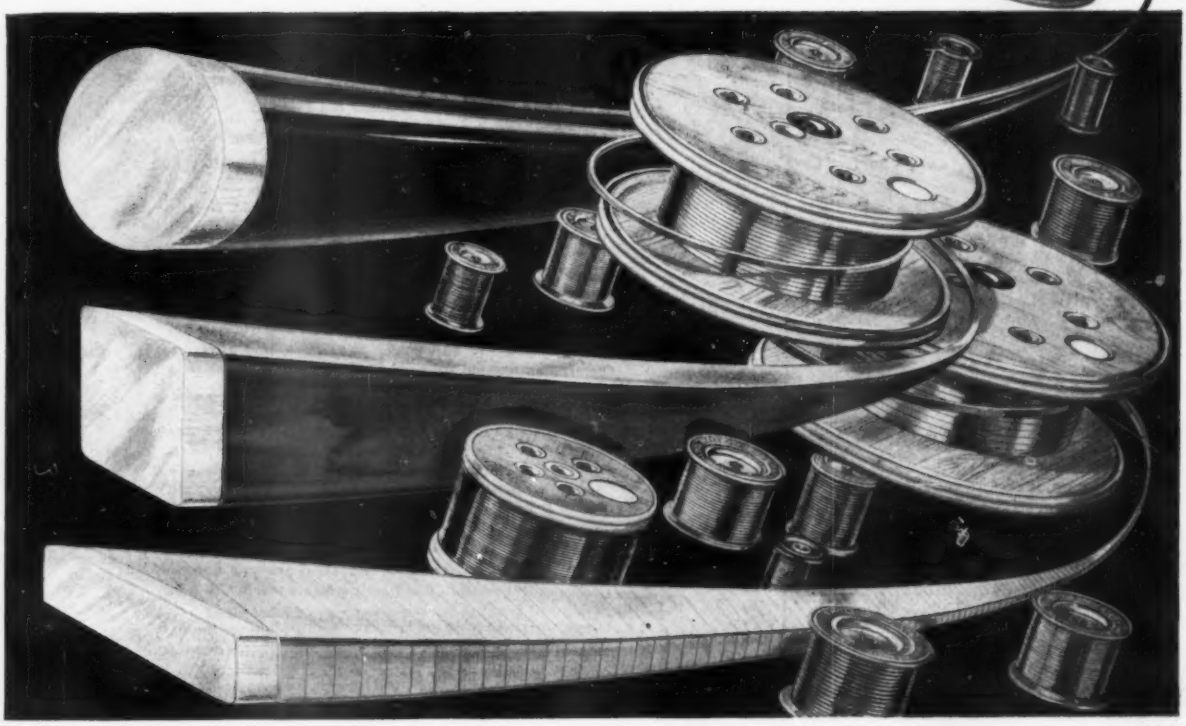

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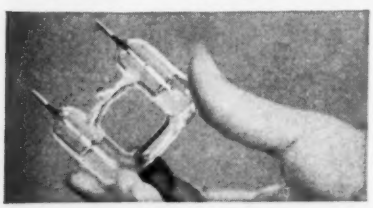
NORTHROP DUPLICATES HUMAN EAR

For use in its Guided Missile Programs

(HAWTHORNE, CALIF.) Scientists at Northrop Aircraft have duplicated the balance mechanism of the human ear in perfecting a highly effective "brain" unit for use in Northrop's advanced guided missile programs. Weighing little more

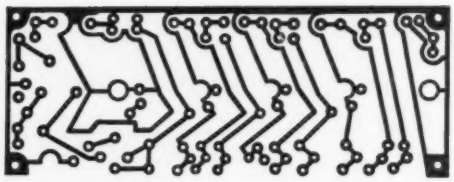


than an ounce, it resembles the convolutions of the inner ear in shape. Northrop engineers say the new instrument is so sensitive that if installed at the top of the Washington Monument it could detect the vibrations created by the footsteps of a small child entering the door at the base of the edifice.

The instrument consists of twin tubes of glass joined at the bottom by two smaller glass tubes. An electrolytic solution, precisely injected by a hypodermic needle, covers tungsten electrodes after they are fused into the glass. These are connected to an AC Wheatstone bridge circuit.

Scientists describe this sensitive device as a manometer accelerometer. In lay terms it is known as a "flying plumb bob," because it can continuously report to the complex automatic guidance "brain" of a missile even the slightest course deviation. It can also be used as an accurate vertical-sensing device in military weapons and for automatic precision leveling in survey operations. It also has potential use in preparing seismographs of earth movements.

At Northrop Aircraft, advanced projects such as this are a constant challenge to the electrical engineer's ingenuity and skill. Here, far-seeing planning has won for Northrop the distinction of being a pioneer in many fields of advanced engineering that relate to the development of supersonic aircraft and missiles.



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ELECTRICAL GROUP, which is responsible for the design of such things as power generation and distribution systems, rectifiers and power converters, and auxiliary systems as applied to manned aircraft, guided missiles and ground support equipment.

COMMUNICATIONS AND NAVIGATION GROUP, which is responsible for the design of C/N systems in manned aircraft and installation of guidance systems in missiles.

FIRE CONTROL RADAR GROUP, which is responsible for the installation and application of the most advanced type of fire control systems in fighter-interceptor aircraft. The work covers the installation of the equipment and associated wiring; continuing liaison with equipment manufacturers; preparation of system analysis and reports; and follow-up of system performance in the field as aircraft become operational.

INSTRUMENT GROUP, which is responsible for the design of instrument systems for manned aircraft and the installation of flight test instrumentation for guided missiles.

There are also opportunities for draftsmen with either electrical or mechanical experience.

At Northrop Aircraft you will be with a company that has pioneered for seventeen years in missile research and development. Here you can apply your skill and ability on top level projects such as Northrop's new supersonic trainer airplane, Snark SM-62 intercontinental missile, and constantly new projects. And you'll be located in Northrop's soon to be completed multi-million-dollar engineering and science building, today's finest in comfortable surroundings and newest scientific equipment.

If you qualify for any of these representative positions, we invite you to contact the Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., ORegon 8-9111, Extension 1893, or write to: 1015 East Broadway, Department 4600-BB, Hawthorne, California.

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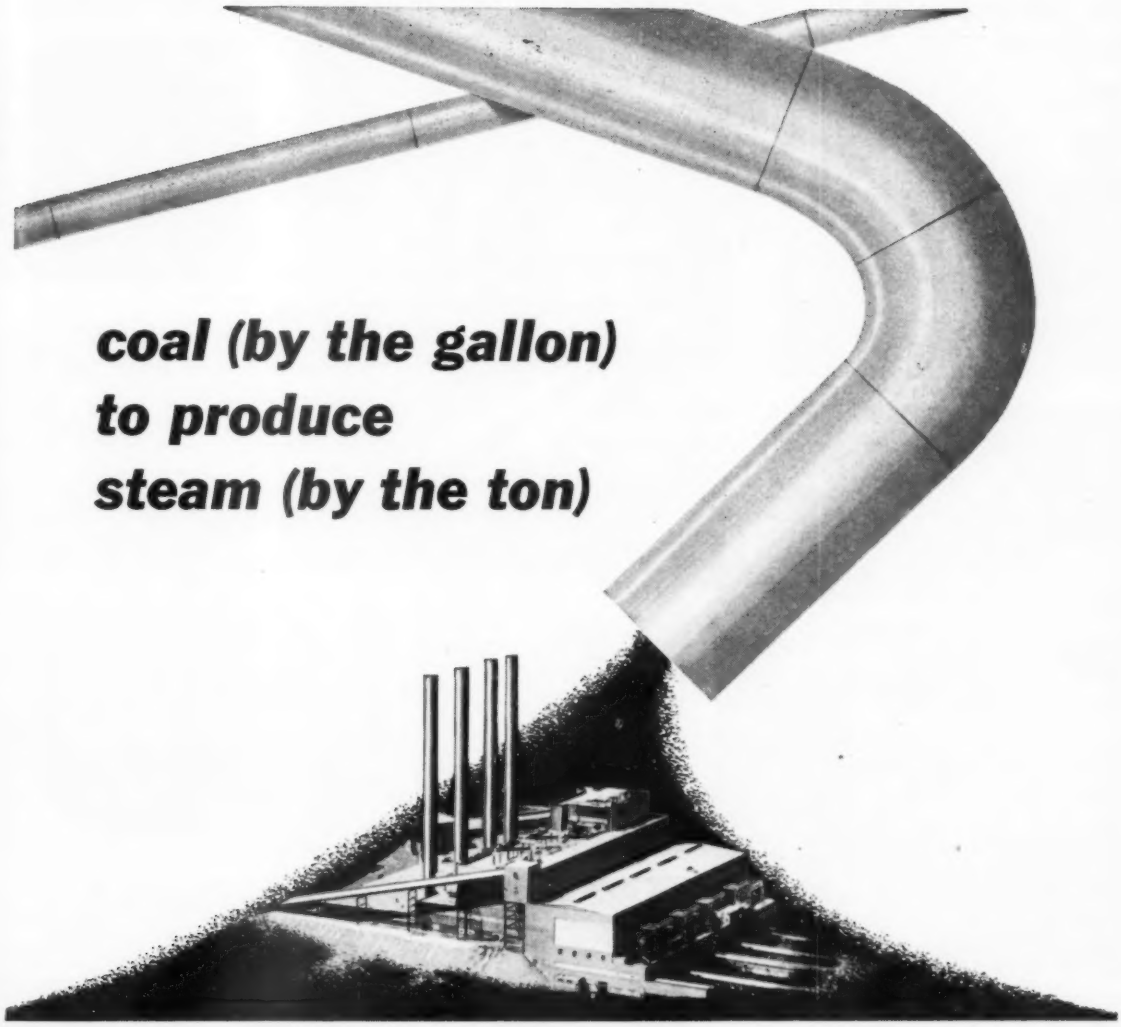

coal (by the gallon) to produce steam (by the ton)

In September 1956, the laying of the pipe for the first long-distance commercial *coal pipeline* in the United States was completed. This unique pipeline—108 miles long—is capable of delivering 150 tons of coal per hour... from the Georgetown, Ohio, properties of Pittsburgh Consolidation Coal Company to the Eastlake plant of The Cleveland Electric Illuminating Company. The coal will be pumped in the form of a "slurry" —a 50-50 mixture of crushed coal and water.

At Eastlake—one of the country's most efficient power stations—the slurry will be delivered to thickeners, vacuum filters, and a battery of C-E Raymond Flash Drying Systems manufactured by Combustion Engineering. Together, these will remove the moisture at the rate of 36,000 gallons per hour. The dried coal will then be pulverized in C-E Raymond Bowl Mills and burned in four mammoth Combustion boilers of the Controlled Circulation type, together capable of producing over 2,000 tons of steam per hour.

Combustion's participation in this project is another instance of its leadership in pioneering improved means for fuel utilization. Throughout the free world, C-E enjoys a reputation for the most advanced engineering in steam generation and related fields. Whether your steam requirements can best be met by coal, oil, gas, or any of a number of special fuels—and regardless of the type or size of boiler you need—the C-E line of fuel burning and steam generating equipment can supply just the right installation for your needs.

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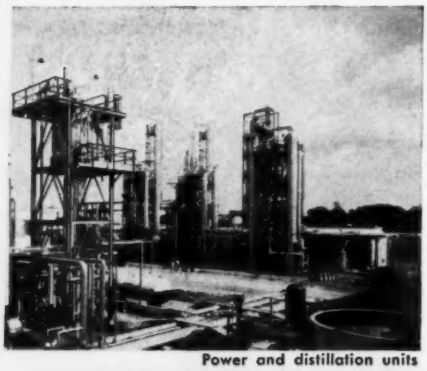
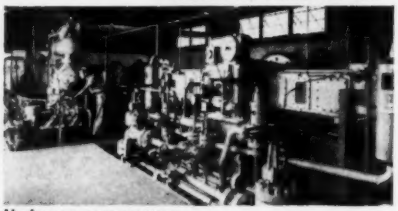
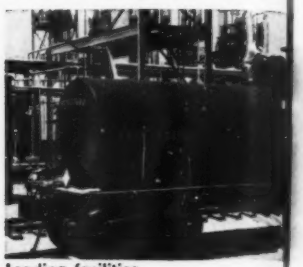


Power and distillation units

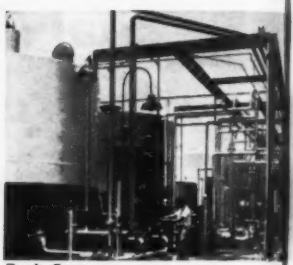


Hydrogen compressors

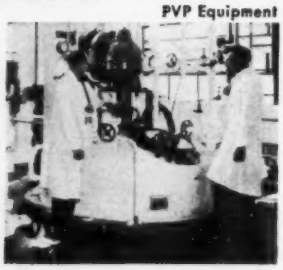
Distillation Units



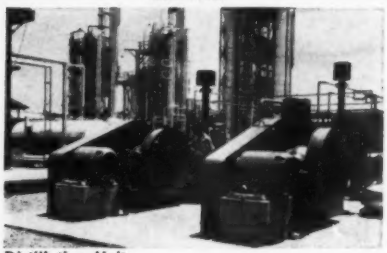
Loading facilities



Tank Farm



PVP Equipment



Distillation Units

PVP building

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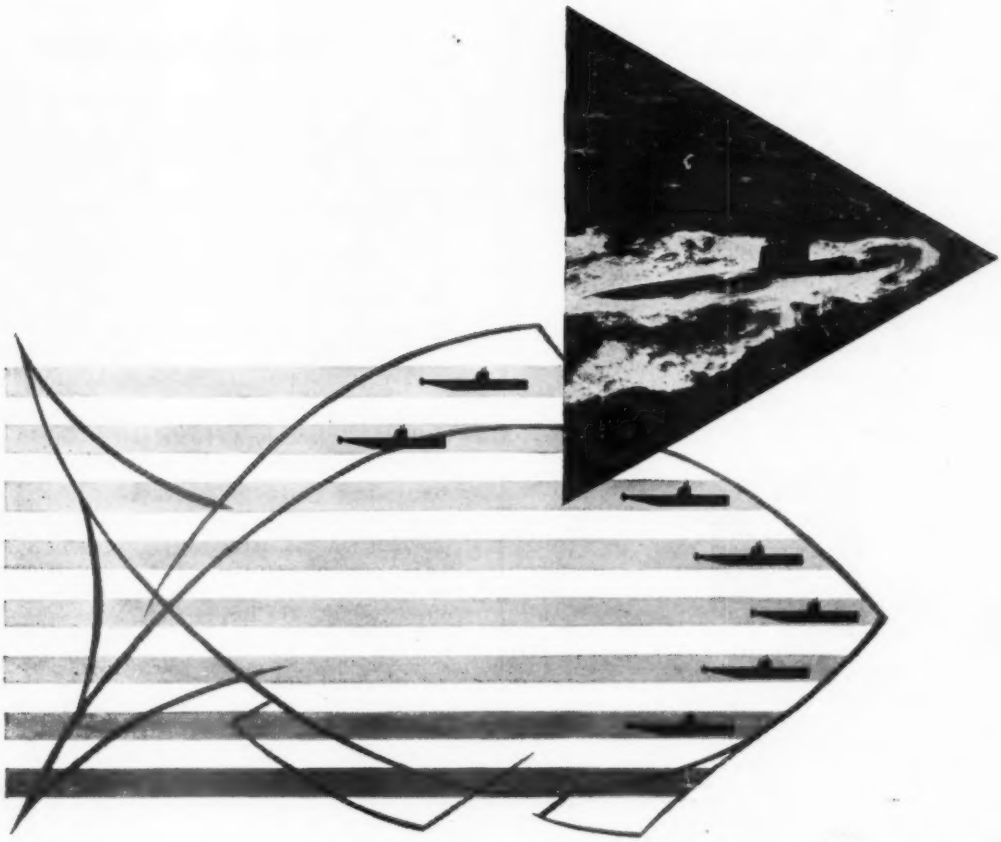

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THE TABULAR VIEW

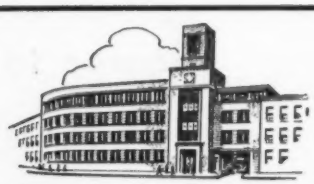
Financially Sound. — In his annual report (page 92) to the M.I.T. Corporation, JOSEPH J. SNYDER, 2-44, Vice-president and Treasurer, since 1952, recorded the Institute's financial position as being sound, and that well over half of the Institute's current revenue for academic operations was provided by industry and the government. Mr. Snyder was also able to report that gifts for the past year (amounting to $10,387,000) exceeded those at the peak of the Development Program in 1950-1951. Mr. Snyder received the B.S. degree from Carnegie Institute of Technology in 1931, and the M.B.A. degree from the Graduate School of Business Administration, Harvard University, in 1934. He became assistant treasurer of the Institute on January 1, 1946, and treasurer on July 1, 1950, upon the retirement of Horace S. Ford.

Industrial Atomic Energy. — As recorded in this issue (page 93) the Institute's graduate program at Oak Ridge provides unusual opportunity for graduate students to acquire professional training in industrial operations involving chemical engineering with special emphasis on atomic energy. The Review's article is written by Professors J. EDWARD VIVIAN, '39, and ROBERT C. REID, '54, both of whom have directed the Engineering Practice School at Oak Ridge.

Born in Montreal in 1913, Professor Vivian was graduated in chemical engineering from McGill University in 1936. From M.I.T. he received the S.M. degree in chemical engineering in 1939 and the Sc.D. degree in 1945. He was made assistant professor in 1942 and became associate professor of chemical engineering and director of the School of Chemical Engineering Practice in 1946. Two years later he became director of the Oak Ridge Engineering Practice School, and in 1956 was appointed professor of chemical engineering.

Born in Denver in 1924, Professor Reid was graduated from the East Denver High School in 1942, and from the U.S. Merchant Marine Academy at Kings Point in 1945. Purdue University awarded him the B.S. degree in 1950 and the M.S. in 1951. In 1954 he received the Sc.D. de-

(*Concluded on page 76*)



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PANEL INSTRUMENTS

THE TABULAR VIEW

(*Concluded from page 74*)

gree from M.I.T. He was appointed assistant professor in 1954, and at that time became director of the Engineering Practice School at Oak Ridge. He returned to M.I.T. this fall.

Exceptional Youths. — Honors come to most people — if they come at all — too late to do them any real good. But, as recorded on page 97, an award recently established as a memorial to Robert Lansing Hardy, '53, aims to provide stimulus and incentive to youths of exceptional merit while such honors can still be an effective spur to professional creativeness.

Visual Probe. — Few members of the Institute's research staff have made greater personal contributions, or have worked under more difficult conditions, than CLIFFORD M. WITCHER. Blind since infancy, Dr. Witcher used his education in physics as a means for developing electromechanical sensory aids for the blind. Engineering on the visual probe (page 98), was completed and the first group of experimental units was ready for field tests when death came to Dr. Witcher. An obituary notice appears on page 88. Long associated with Dr. Witcher, Lamar Washington, Jr., assisted in seeing his article through production.

Olympics Bound. — M.I.T. Sailing Master WALTER C. WOOD, '17, emphasizes the value of sailing at the Institute in his account (page 100) of the part Technology sailors are playing at the Olympics at Melbourne Bay this year.

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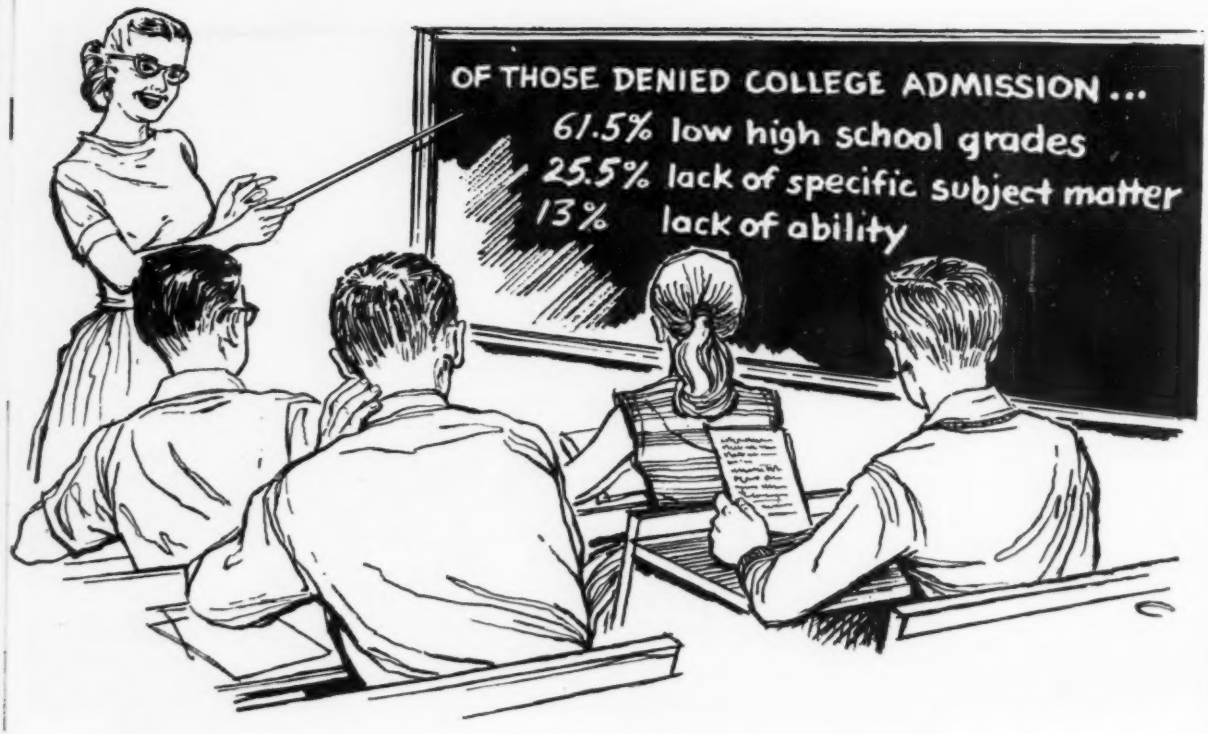
Can your child go to your college?



Every one of us has the hope that his son or daughter may be so well prepared that the admissions officer will say: "Your application is accepted. We will look forward to seeing you in the fall." But sometimes plans go amiss.

We at General Electric have for years been urging youth to aim high, work hard, master the basic subjects, and go on to college.

Recently, we sent a questionnaire to 100 college-admissions officers. We asked: "What are the reasons some high-school students are admitted and others rejected?" The 78 replies we received contained a great unanimity of opinion.

We have summarized those replies in a booklet, *Start Planning Now for Your Career;* the illustration on this page, taken from the booklet, gives a clue as to its content.

We believe that the alumnus can work for the best interests of his college by sending to that college young people prepared to receive a higher education.

We further believe that our summary of opinions of admissions officers is so persuasively compelling that the boy or girl who reads it must ask himself whether he is choosing his courses wisely and getting high enough marks.

Perhaps with this booklet in hand and supporting its thesis with your own experience, you can help persuade your child, or another child in whom you have an interest, to prepare against the day when an admissions officer will review his record. We invite you to write for a copy (or copies) to Dept. 2-119, General Electric Company, Schenectady, New York.

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Technology Review

TITLE REGISTERED, U. S. PATENT OFFICE

Edited at the Massachusetts Institute of Technology

VOL. 59, NO. 2 DECEMBER, 1956

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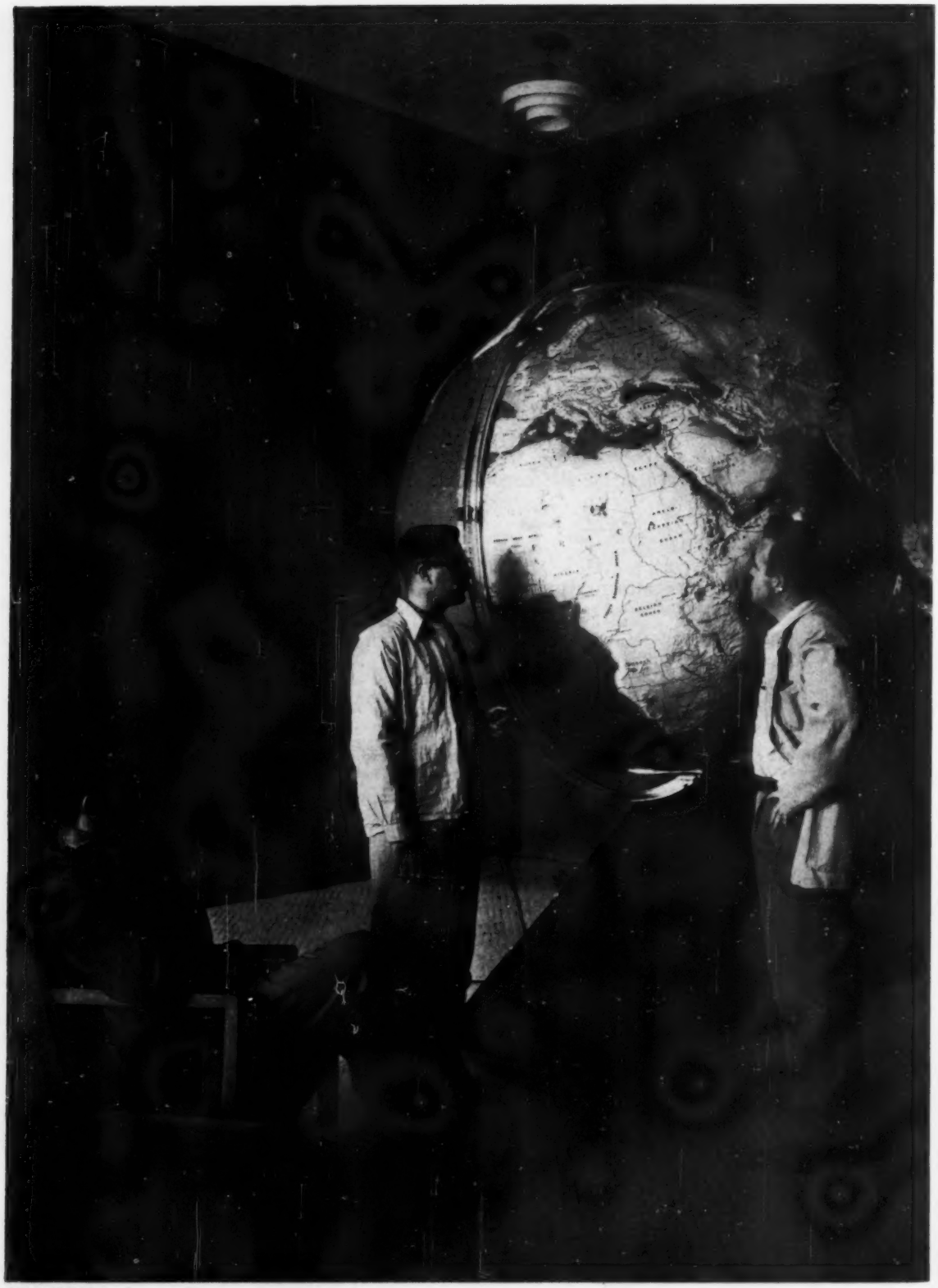


M.I.T. Photo

The World at Your Finger Tips

Technology students have excellent opportunity to follow world events through facilities of the Boston Stein Club Map Room in the Charles Hayden Memorial Library, which contains this huge orographical globe, a gift from Harry H. Young, '91

The Technology Review

VOL. 59, No. 2 DECEMBER, 1956

The Trend of Affairs

Nobel Prize in Physics

■ Three American physicists – including a Technology Alumnus – who worked together to develop the theory and practical application of transistors are recipients of the Nobel Prize in physics this year. They are John Bardeen of the University of Illinois, Walter H. Brattain of the Bell Telephone Laboratories, and William Shockley, '36, Director of the Shockley Laboratory of Beckman Instruments, Inc. All were members of the technical staff of the Bell Telephone Laboratories when they worked on developments for which the Nobel prize was awarded.

The physics award recognizes the swift advance of science and technology in the relatively new and highly important field of solid state physics. It emphasizes the importance of the tiny devices capable of performing virtually all functions of the versatile electron tube, such as is found in radio and television receivers.

The transistor, or "transfer resistor," is essentially a device for conducting electric current better in one direction than in the other. As such, it serves as a rectifier or detector; but it does much more than this. Because a current or voltage applied to input of the device may be made to appear in magnified form at its output, the transistor is able to function as an amplifier and also as an oscillator. In all of these functions it is the first competitor to the versatile electron tube which, incidentally, now has half a century of history.

Transistors are highly efficient – operating from a few dry cells in most applications – very compact, extremely rugged, highly reliable in operation, and appear to have unlimited life if operated within their ratings and not subjected to high humidity or temperature. These properties make transistors of considerable value in communications equipment for military purposes, in hearing aids, and in large-scale computer machines where large numbers of electronic operations must be carried out quickly and reliably.

As director of transistor developments for the Bell Telephone Laboratories, Dr. Shockley has played a major role in developing the theory and practical application of these new electronic devices. He was born in London in 1910, and received the Ph.D. degree in physics from M.I.T. in 1936. He was a member of the technical staff of the Bell Telephone Laboratories from 1936 until 1955 when he resigned to become director of the Shockley Laboratory of Beckman Instruments, Inc. in Mountain View, Calif.

Dr. Shockley is author of *Electrons and Holes in Semiconductors with Applications to Transistor Electronics* published by Van Nostrand in 1950. He was elected a fellow of the Institute of Radio Engineers in 1954 and in 1952 received the Morris Liebmann Memorial Prize from the I.R.E. for his contributions to the theory and practical application of transistors. In January, 1953, he was awarded the Oliver E. Buckley Solid State Physics Prize for his important contribution to the advancement of knowledge in solid state physics. He was also awarded the Comstock Prize by the National Academy of Sciences in 1954.

Nick Lazarnick

William Shockley, '36, Walter H. Brattain, and John Bardeen (in usual order) who share the 1956 Nobel Prize in physics for development of the transistor.

M.I.T. Photos

As a result of changes in the Institute's Administration, Francis Bitter, Professor of Physics (left) *becomes associate dean of science, as mentioned on page 85; Carl F. Floe, '35, Professor of Metallurgy and Assistant Provost* (center), *has been named assistant chancellor; and Malcolm G. Kispert, 2-44* (right) *Executive Assistant to the President, has also been named assistant chancellor, as recorded below.*

Assistant Chancellors

■ Appointment of Carl F. Floe, '35, and of Malcolm G. Kispert, 2–44, as Assistant Chancellors of the Institute was recently announced by Julius A. Stratton, '23, Chancellor.

Dr. Floe is professor of metallurgy and since 1952 has served also as assistant provost. Mr. Kispert, a graduate of the Course in Aeronautical Engineering, joined the staff of the President in 1946 to assist the late Karl T. Compton, and since 1952 has been executive assistant to James R. Killian, Jr., '26, President.

In announcing these new appointments, Dr. Stratton said:

The establishment of the assistant chancellorships marks another step in our effort to keep pace administratively with the rapid growth and expanding obligations of the Institute. Both Dr. Floe and Mr. Kispert have had long experience in academic and administrative affairs at M.I.T. They have gained through this association an extraordinarily wide and intimate acquaintance with our Faculty and staff, and enjoy the esteem of their colleagues for unfailing skill and understanding in dealing with Institute affairs. I feel most fortunate to have their support in fulfilling the duties of my office. The assistant chancellors will share with the deans of the Schools and myself the task of carrying on the academic affairs of the Institute.

Dr. Floe will represent me on all matters relating to research and will provide the necessary co-ordination with the vice-president for Industrial and Governmental Relations, and with the Division of Sponsored Research. I shall turn to him frequently on matters pertaining to the professional schools and special projects such as new laboratories and other facilities. In addition, Dr. Floe will carry the administrative responsibility of this office for the Summer Session and the Library.

Mr. Kispert will assume management of the budget of the Institute. In this he will work closely with the vice-president and treasurer to assure the most prompt and effective use of these funds in the interests of the academic departments. Because of his experience and familiarity with student life at the Institute, I shall ask Mr. Kispert to provide the necessary liaison with the dean of students to effect proper administrative support of student affairs. He will also handle the administrative responsibility of the Chancellor's Office for the Registrar's Office and the Medical Department.

Born in Dawson, in the Klondike Region of the Yukon Territory, Dr. Floe received degrees of bachelor of science and master of science at Washington State College in 1930 and 1932. M.I.T. awarded him the degree of doctor of science in metallurgy in 1935. He served as an instructor in metallurgy at Washington State College from 1930 to 1934 and as assistant professor from 1935 to 1936. In 1936 he joined the faculty of the University of Notre Dame and three years later returned to M.I.T. He became an associate professor in the Department of Metallurgy in 1942, executive officer of the Department in 1943, and a full professor in 1950.

Dr. Floe is a member of Sigma Xi, Tau Beta Pi, Sigma Tau, Alpha Chi Sigma, the American Institute of Mining and Metallurgical Engineers, the American Society for Metals, the Iron and Steel Institute in London, and the Institute of Metals in London. He is also a member of the University Club of New York and St. Botolph Club of Boston. He is married to the former Miss Beverly Brooks of Boston and they have four children. Their home is in Belmont.

Mr. Kispert, the son of Mr. and Mrs. Edwin P. Kispert of Touisset, Mass., was born in Fall River in 1923, attended Durfee High School in that city and entered M.I.T. in 1940. He enlisted in the United States Navy in 1942, continuing his studies in uniform under the V-12 unit at M.I.T., and received the degree of bachelor of science in February, 1944. He then served as an aviation engineering officer in the Pacific. From January to September, 1946, he took

graduate work in Aeronautical Engineering at M.I.T. and was awarded the degree of master of science in Aeronautical Engineering.

Mr. Kispert is a member of the Institute of the Aeronautical Sciences, Tau Beta Pi, and of the St. Botolph Club of Boston. He is a director of the Harvard Co-operative Society. He was married to Miss Janice McCreery of Fall River in 1944. They have four children, and their home is in Waban, Mass.

Executive Assistant

■ James R. Killian, Jr., '26, President of the Institute, has announced the appointment of James G. Kelso, a member of the Faculty, as his executive assistant. Dr. Kelso succeeds Malcolm G. Kispert, 2–44, recently appointed Assistant Chancellor. In announcing this appointment, Dr. Killian said:

> Because of his broad experience in the academic field and in dealing with students, with industry, with government and with research agencies, Dr. Kelso is particularly fitted to assist in the multiplicity of matters coming up in the President's Office. His service to the Institute has been very important and I shall continue to rely upon him.

A native of Worcester, N.Y., Dr. Kelso attended Dartmouth College and was awarded A.M. and Ph.D. degrees by Harvard University for graduate study in American history. He served as a paratrooper during World War II, entering the Army as a private in 1941 and being discharged in 1946 as a lieutenant colonel. He made jumps in Sicily, Normandy, Holland, and Germany, holds eight battle stars, and was awarded the silver star for gallantry in action. Portrait illustration of Dr. Kelso appears on page 86.

Dr. Kelso joined the M.I.T. Faculty, to teach history, in 1948 and holds the rank of assistant professor. He became associate placement officer in 1955, taking the responsibility for guidance of industry and of students in the difficult field of attempting to supply engineers and scientists to meet the crucial demand. Last July he became placement officer, in charge of an office which took over the responsibility for placement of Alumni as well as students.

Dr. Kelso is married to the former Miss Dorothy Honiss of West Hartford, Conn. They live in Winchester and have two children.

Associate Dean of Science

■ Appointment of Professor Francis Bitter as Associate Dean of the School of Science at the Institute was announced in October by George R. Harrison, Dean of the School. Professor Bitter is internationally noted for his application of modern physics and atomic structure to the understanding of the mechanical and magnetic properties of metals, and to the unraveling of nuclear structure by means of spectroscopy. In making the announcement, Dean Harrison said:

> The School of Science is especially fortunate in obtaining as its associate dean a person of Professor Bitter's talents and experience in the improvement of undergraduate education, as well as in the proper balancing of this in relation to graduate education and to research. He has in the past few years made signal contributions to the freshman and sophomore teaching of physics at the Institute. With the science department heads and others who are working continually on the improvement of educational methods, Dean Bitter can be expected to make further outstanding contributions.

Dr. Bitter came to M.I.T. as a member of the teaching staff in 1934, and has been a full professor in the Physics Department since 1951. He is the son of the distinguished American artist, the late Karl Bitter. His wife, Ratan Devi, a singer, is well known in musical circles for her interpretation of the music and spirit of India.

Born in Weehawken, N.J., on July 22, 1902, Dr. Bitter attended Columbia University, where he was graduated in 1924 with the degree of bachelor of science. After further study, including a year in Berlin, he was awarded the Ph.D. degree by Columbia in 1928. After two more years of study and research, in which he specialized in the theory of magnetism at Princeton University and California Institute of Technology, he joined the staff of the Research Department of Westinghouse Electric Company.

Dean and Mrs. Bitter make their home at 44 Gerry's Landing in Cambridge.

On the Horizon

January 30, 1957 – Midwinter Meeting of the Alumni Association. Walker Memorial, M.I.T. Campus. (Dinner 6:00 P.M. Reservations should be made through Alumni Office, Room 1–280, M.I.T.)

February 2, 1957 – 9th M.I.T. Alumni Regional Conference, Tulsa, Okla. Theme: "Conference on Engineering and Science – M.I.T.'s Salute to Oklahoma's Golden Jubilee." **Speakers:** President Killian; Deans E. P. Brooks, '17, and George R. Harrison; Professors Warren K. Lewis, '05, Robert R. Shrock, John G. Trump, '33, and Jerrold R. Zacharias. (For further information, consult Barrett B. Russell, 3d, '43, E. I. du Pont de Nemours and Company, 1811 South Baltimore Avenue, Tulsa 19, Okla.)

February 16, 1957 – 10th M.I.T. Alumni Regional Conference, Chicago, Ill. **Speakers:** President Killian; Deans E. P. Brooks, '17, and Pietro Belluschi; Professors Walter G. Whitman, '17, and John E. Arnold, '40. (For further information, consult John R. Kirkpatrick, '48, Arthur D. Little, Inc., 9 South Clinton Street, Chicago 6, Ill.)

February 22–25, 1957 – "M.I.T. Week End in Havana," M.I.T. Club of Cuba. (For reservations, consult Antonio Helier Rodríguez, '21, Concordia 61, Havana, Cuba.)

March 14–16, 1957 – 9th Annual Fiesta, M.I.T. Club of Mexico, Mexico City, D.F. (For reservations consult Clarence M. Cornish, '24, Margaritas 139, Villa Obregon, Mexico 20, D.F., Mexico.)

June 10, 1957 – 23d Alumni Day, 1957, M.I.T. Campus in Cambridge.

M.I.T. Photos

Promotions have recently been announced for: James G. Kelso** (left) **who leaves his post as placement officer to become executive assistant to President Killian; Joe Jefferson** (center) **who becomes placement officer; and W. Van Alan Clark, Jr., '42** (right) **recently named assistant dean of the School of Industrial Management.

Assistant Dean

■ Appointment of Associate Professor William Van Alan Clark, Jr., '42, as Assistant Dean of the School of Industrial Management at the Institute was announced this fall by Dean E. P. Brooks, '17.

Dean Clark received his B.A. from Williams College in 1941 and his master's degree in Business and Engineering Administration at M.I.T. in 1942. He served as gunnery and torpedo officer in the U.S. Navy from 1942 to 1946. He has been a member of the Faculty of M.I.T. since 1946, being first appointed as an instructor in the Department of Business and Engineering Administration. He became an assistant professor in 1947 and in 1953 was made an associate professor.

In his new post, Dean Clark will continue as chairman of the Undergraduate Committee of the School of Industrial Management and will assist the Dean in the development programs of the School.

Dean Clark has been active in the Society for the Advancement of Management and the American Material Handling Society and is a director of a number of companies. He has taken active part in civic affairs in his home community of Lincoln, Mass. He and Mrs. Clark, the former Mary Harris, are the parents of five children.

Placement Office

■ Consolidation of all M.I.T. placement activities in a single office was announced during the summer by Admiral Edward L. Cochrane, '20, M.I.T. Vice-president for Industrial and Governmental Relations.

Joe Jefferson, formerly Assistant Director of Student Aid, has been appointed placement officer in charge of the new office. He succeeds James G. Kelso who has been appointed executive assistant to President Killian. Mrs. Evelyn B. Yates has been named associate placement officer, and Mrs. Mary D. Howe, assistant placement officer. Mrs. Yates and Mrs. Howe have served with distinction in important posts in the Alumni Placement Office.

"The purpose of the consolidated office," said Admiral Cochrane, "is to give better continuity, from graduation to retirement, to our services in placement planning for M.I.T. men. The new consolidated office should also help M.I.T. serve the interests of industry and government more effectively."

Student and alumni placement at M.I.T. were formerly conducted in two separate offices under the direction of the late Nathaniel McL. Sage, '13, who until his death last May had served as both placement officer and director of the Office of Sponsored Research at M.I.T.

Admiral Cochrane reported that for the first time the number of companies and governmental agencies that sent recruiting teams to M.I.T. last year exceeded 800.

Mr. Jefferson, the new placement officer, was born in New York and was graduated from Columbia University in 1947. He served in the business training program of General Electric Company, was assistant director of the Ottilie Home for Children in Jamaica, N.Y., was director of the Big Brother Camp in New York, and then was a staff assistant of the College Entrance Examination Board in New York. He came to M.I.T. in 1954 as assistant to the Director of Admissions and became assistant director of student aid later that year. Mr. Jefferson and his wife, the former Miss Shirley Cushman of Auburn, Maine, live in Lexington. They have three children.

Mrs. Yates, who is a native of Phillips, Maine, grew up in Berlin, N.H. A graduate of Wellesley College, she worked in the Placement Office there before becoming alumni placement officer at M.I.T. in 1942.

Mrs. Howe was born in Dorchester, Mass., and was educated in the Boston public schools. She took her A.B. and A.M. degrees at Radcliffe and has been assistant alumni placement officer at M.I.T. since 1954.

Twenty-five Years Ago This Month . . .

■ Despite the ever-deepening effects of the great depression,* the Institute approached the Christmas season of 1931 heartened by the fiscal report of Treasurer Everett Morss, '85, covering 1930–1931, and the official registration figures of Registrar Joseph C. MacKinnon, '13, for 1931–1932.

Mr. Morss reported that on the previous June 30 the book values of the Institute's "land, buildings, and equipment" and its "endowment funds" were recorded, respectively, as being $14,682,737 and $33,821,588. Moreover, during 1930–1931 net income had passed the two and three-quarter million mark for the first time, being $2,880,131, while net expense had exceeded net income only by $37,907.

Mr. MacKinnon's census, made as of November 1, was equally reassuring in that he found the total student body to number 3,188, only 21 less than a year before. There was to be noted a welcome increase of 49 (10 per cent) in the number of graduate students compared with November, 1930, but there was also ominous cause for concern because of a decrease of 107 (14.7 per cent) in the number of entering freshmen. There were only 630 entering as the Class of 1935 compared with 737 who had started the year before as the Class of 1934.

. . . Answers received from 1,344 Alumni replying to a questionnaire addressed to approximately 2,500 readers of The Review disclosed that their average salary was $7,073 and their average annual income from investments was $5,836. Of the 1,344 Alumni, 654 (49 per cent) who were under 36 years of age reported a salary average of $4,001; 513 (37 per cent) aged 36 to 55 reported $10,394; and 177 (14 per cent) aged over 55 reported $11,751.

. . . Congratulations were being extended to Bradley Stoughton, '96, and Samuel G. Porter, '03, upon their elections to the presidencies of the American Electrochemical Society and the Engineering Institute of Canada; and to two members of the Class of 1916, Thomas D'A. Brophy and Robert E. Wilson, upon their becoming, respectively, vice-president of Kenyon and Eckhardt and a director of the Standard Oil Company of Indiana.

. . . It was reported in The Review for December, 1931, that "the new underpass is now nearing completion at the juncture of Memorial Drive and Massachusetts Avenue."

* It was a time when notice was given in The Review's advertising columns that the 23 hotels comprising the United chain offered "room rates reduced 10% to 30%" and the Shelton in New York quoted "$4.00 per day double with bath"; when a "delightful cabin" to Europe on the S.S. *Leviathan* of the U.S. Lines, current queenship of the Atlantic, was open at "$122.50 (up) Tourist Class"; and when one could buy a tuxedo as low as $45 at the Coop, or an ordinary suit as low as $35!

M.I.T. Photo

The George Eastman Research Laboratories (Building 6) under construction 25 years ago during the autumn of 1931. At the left: the recently completed Spectroscopic Laboratory, in its specifications so vibration-free "that a large metal mirror suspended at the end of a lever 35 feet long is not expected to quiver so much as one-25,000th of an inch." At the upper right: the running track subsequently removed to the west of Massachusetts Avenue to make room for the Alumni Pool in 1940.

Prize for Straight "A"

■ A young Connecticut student, who was the only freshman to receive a straight "A" average at the Institute last year, received M.I.T.'s first Borden Freshman prize for scholarly achievement this fall. He is Hayward R. Alker, Jr., '59, of Greenwich, Conn., shown at the right, who was also the top student each of the three years he attended the Brunswick School in Greenwich. A letter man in baseball at Brunswick, he was also active in debating and a member of the Glee Club.

The Borden Freshman Prize which Alker received is to be awarded annually at M.I.T. and is sponsored by the Borden Company Foundation "to emphasize the importance of good scholarship." It was presented by Charles N. Satterfield, '43, Associate Professor of Chemical Engineering and chairman of the Faculty's Freshman Advisory Council, at the first all-student convocation of the current year on September 26.

M.I.T. Photo

Season's First Council Meeting

■ The 319th meeting of the Alumni Council (the first of the current school year) was held on the evening of Monday, October 29, at the M.I.T. Faculty Club in the Sloan Building. Theodore T. Miller, '22, President of the Alumni Association, presided at this meeting which was attended by 161 members and guests. Each Council member was presented with a folder containing an advance copy of President Killian's Annual Report to the Corporation, a report on the Alumni Fund Conference (summarized on pages 24 and 25 of the November, 1956, issue of The Review), and a mimeographed roster of the proposed membership of the Alumni Council for the coming year.

Items of business at this dinner meeting included a report by Edwin D. Ryer, '20, chairman of the Committee on Audit and Budget, that the Association's accounts had been examined during the summer and the audit had been approved by his committee. Avery H. Stanton, '25, chairman of the Alumni Fund Board, reported on the Alumni Fund Conference held at M.I.T. on September 7 and 8, and expressed the hope that this year the Council would be the first alumni group to obtain 100 per cent participation in the Alumni Fund.

As Secretary-Treasurer of the Association, Donald P. Severance, '38, reported that nine changes in class affiliation had recently been approved; that since June 15, visits to 30 M.I.T. Clubs have been made by 17 members of the M.I.T. staff and officers of the Alumni Association; that the Association's budget for the fiscal year 1955–1956 was $67,053 and that income from The Review was sufficient to cover a deficit of $1,619, turn over $5,000 to the Alumni Fund, and add an additional amount to the Alumni Reserve Fund; that net cost to the Alumni Association for the 1956 Alumni Day was $3,866.71 compared to $3,524 in 1955 and $5,140 in 1954. Mr. Severance also submitted for vote of the Council the names of Class Representatives, Club Representatives, and new Associates to serve on the Council, and personnel of a committee on observance of the Institute's 100th anniversary. He also submitted names of 30 new nominations and 20 renominations of Alumni to serve on Visiting Committees. In accepting the Secretary's report, all committee personnel were elected for the specified terms of office by the Council.

Ernest C. Crocker, '14, presented the report of the Committee on Resolutions for the late Chester A. Corney, '14, a former member of the Council, which report was accepted by a silent rising vote.

President Miller forecast that more and more Technology Alumni would have an opportunity to participate in worth-while projects of the Association, some of direct benefit to the Institute and the Association and others on a scale transcending M.I.T. He expressed the hope that the Alumni Council would become increasingly a Council of action and stated that Council members would soon see, initiated in the Cambridge area, some of the projects being encouraged in areas where there are M.I.T. Clubs. At the conclusion of these remarks, President Miller called

(*Concluded on page 116*)

Clifford M. Witcher: 1914-1956

■ Clifford M. Witcher, Director of the Sensory Aids Project of the Research Laboratory of Electronics, died at his home in Belmont, Mass., on October 6. He was 42 years old. Dr. Witcher, blind since infancy and long a devoted research scientist working on aids for the blind, had just completed his latest invention, an electronic Audible Vision Probe. The first 50 probes were recently manufactured and delivered to the American Foundation for the Blind in New York for distribution and testing. The light-sensitive probe, of fountain-pen size, generates to a hearing-aid type earphone a tone which varies in pitch with the degree of light and shade encountered by the instrument. This device, which is as effective for reading electrical meters or operating switchboards as for locating doors and windows or determining margins and letterheads on stationery, was perfected by Dr. Witcher during three of his five years on the M.I.T. research staff.

A native of Atlanta, Georgia, Dr. Witcher earned the degrees of bachelor of science at Georgia Institute of Technology, master of arts at Emory University, and doctor of philosophy at Columbia University. Before his M.I.T. appointment, he conducted radar research at the Bell Telephone Laboratories from 1943–1946, sensory aid research for the Haskins Laboratories from 1946–1947, and general research on appliances for the blind for the American Foundation for the Blind from 1947–1951. In addition to his "Symposium on Blindness," Dr. Witcher was the author of numerous technical articles and papers.

Choral Society Scores European Success

■ The M.I.T. Choral Society stormed the bastions of great music in Germany this summer, and ovations were almost universal. There were some catcalls too, and the 62 singers are still laughing about this.

According to Billy H. Burdine, '52, President of the Society, the one time during the 21 day tour when the audience did not respond to a concert with unanimous acclaim was at the Festival of Contemporary Music at Darmstadt, which happens to be the location of a summer school of extreme musical modernists.

Now Stravinsky is generally regarded as about as modern as any composer. His "Mass," which the M.I.T. singers presented at Darmstadt, was written only eight years ago. But a few young composers and students in the audience — members of the extreme 12-tone school of modern composition and in violent disagreement with Stravinsky — began hooting and whistling as soon as the "Mass" had been concluded.

The rest of the audience and the Darmstadt press were very indignant about this discourteous demonstration. The touring group from M.I.T. thought it was funny.

But to most Germans, to whom Haydn and Mozart are almost sacred, the Choral Society sang Mozart and Haydn, as well as Stravinsky and Honegger, with great musicianship.

(*Continued on page 108*)

Individuals Noteworthy

■ Featured in the autumn news have been the 21 promotions, elections, or appointments cited below:

Henry R. Kurth, '21, as Vice-president, Boston Edison Company . . . *Bernard L. Chapin, '23,* as President, New England Carbide Tool Company, Inc. . . . *Walter F. Munford, '23,* as Assistant Executive Vice-president, United States Steel Corporation;

James H. Doolittle, '23, as chairman, National Advisory Committee for Aeronautics (succeeding Jerome C. Hunsaker, '12, who served as chairman 1941–1956) . . . *Antonio Rosado, Jr., '24,* as President, Cuban Telephone Company . . . *Marshall N. Waterman, '24,* as President, Illuminating Engineering Society;

Bernard E. Groenewold, '25, as President, Exploration Drilling and Oil Company, Tulsa, Okla. . . . *Arthur J. Connell, '27,* as Vice-president, Stone and Webster Engineering Corporation . . . *José D. Domingüez, '27,* as President, Puerto Rico Telephone Company;

Joseph K. Roberts, '28, as Vice-president in Charge of Research and Development, Standard Oil Company of Indiana . . . *Bruce E. Sherrill, '28,* as President, Daugherty Company, Inc., Youngstown, Ohio . . . *Allan Intriligator, '30,* as President, Mandel Brothers, Chicago;

Joseph R. Stevens, '30, as Executive Vice-president, J. T. Baker Chemical Company . . . *Robert C. Gunness, '34,* as Executive Vice-president, Standard Oil Company of Indiana . . . *W. Gardner Barker, '37,* as Vice-president, Thomas J. Lipton, Inc.;

Edward C. Peterson, '37, as Vice-president, Rolling Mill Equipment Division, Birdsboro Steel Foundry and Machine Company . . . *Nicholas H. Wheless, Jr., '38,* as President, Wheless Drilling Company, Shreveport, La. . . . *Thomas F. Creamer, '40,* as Vice-president, The First National City Bank of New York;

Howard O. McMahon, '41, as Vice-president, Arthur D. Little, Inc. . . . *George J. Schwartz, '42,* as Vice-president and General Manager, Doelcam Division, Minneapolis-Honeywell Regulator Company . . . *Dr. James M. Faulkner,* Institute Medical Director, as a member of the National Board of Medical Examiners.

■ Special honors came these past months to *William Shockley, '36* (*see* page 83) and the 11 other Alumni enumerated below:

To *Donald W. Douglas, '14,* the 1956 annual award of the National Defense Transportation Association to "the person who has made the most outstanding contribution to military transportation in the preceding year" . . . *Kenneth E. Bell, '17,* the Order of Cedars, Officer Grade, by the Government of Lebanon . . . *Barnett F. Dodge, '17,* an honorary doctorate of science, by Worcester Polytechnic Institute;

To *Walter J. Hamburger, '21,* the Olney Medal, by the American Association of Textile Chemists and Colorists, awarded annually "to a citizen of the United States, for outstanding achievement in the field of textile chemistry, including the development of chemical agents or chemical processes used in the manufacture of textiles, or methods for their evaluation" . . . *Frederick S. Blackall, Jr., '22,* the Howard Coonley Medal, by the American Standards Association . . . *Oscar H. Horovitz, '22,* his 22d prize won in national or international cinema competitions, for his *Belo Horizonte,* selected as one of the best 10 amateur films in the 1956 International Cinema Competition;

To *Samuel I. Zack, '22,* the James Laurie Prize, by the American Society of Civil Engineers . . . *John E. Burchard, '23,* an honorary doctorate of architecture, by the University of Michigan . . . *Frederick E. Terman, '24,* its first Member-for-Life Medal, by the American Institute of Electrical Engineers . . . *Clarence Renshaw, Jr., '32,* a second Legion of Merit Medal with Oak Leaf Cluster;

To *William A. Baker, '34,* for being naval architect of the second *Mayflower* – the historically accurate full-scale replica of its Seventeenth Century predecessor – now fitting-out at the Stuart Upham shipyards of Brixham, England, from whence it is destined to sail next April on a two-months' maiden voyage to its permanent home port in the United States.

M.I.T. Photo

In addition to President and Mrs. Killian, those at the christening of the new shell included (left to right): Carl A. Boedecker, '58, Frank J. Bielsik, '58, William C. Bowman, '57, Irving L. Weinman, '59, Paul H. Rothschild, '58, Jack R. L'Hommedieu, '57, William N. Latham, '58, Walter W. Wiechmann, '58, and H. Richard Blieden, '57.

"The Liz"

■ A new Technology racing shell was launched in the Charles River after christening ceremonies at the Tech Boathouse on October 18. The new shell comes to the M.I.T. crew as a result of literary efforts exhibited by James R. Killian, Jr., '26, President. As a result of an article in *LIFE* magazine last spring, Dr. Killian received a check which he promptly turned over to the M.I.T. Athletic Association.

In accepting the check on behalf of the Athletic Association, M.I.T. Athletic Director Richard L. Balch stated:

"The M.I.T.A.A. decided to use it for an eight-oared crew shell. It will be named in honor of the president's wife, Mrs. Elizabeth Parks Killian."

After appropriate christening ceremonies by President Killian, the new shell which has been nicknamed "The Liz" (as can probably be seen on the illustration above) was launched about sunset on October 18.

Regional Fund Director

■ The appointment of Joseph E. Conrad to be Regional Director of the Alumni Fund at the Institute was recently announced by Avery H. Stanton, '25, chairman of the Alumni Fund Board.

Mr. Stanton explained that in this new assignment Mr. Conrad will assist Henry B. Kane, '24, Director of the Alumni Fund, in developing a regional organization to supplement the long-standing class organizations for reaching M.I.T. Alumni in behalf of the Fund.

"We are confident that this broadened activity in the M.I.T. Alumni Fund headquarters will make possible still further increases in the Fund's effectiveness in the coming years," Mr. Stanton said in making the announcement. He pointed out that M.I.T.'s Alumni Fund, which last year received contributions of over $576,000, is now the seventh largest Alumni Fund in the United States.

Mr. Conrad attended the public schools of Middletown, Ohio, and is a graduate in business administration from the Ohio State University (1952) where he was a member of Phi Delta Theta fraternity.

After his graduation in 1952, Mr. Conrad became field secretary of the Ohio State University Alumni Association. He was appointed executive secretary of the M.I.T. Club of New York in March, 1955, and in this capacity he had principal responsibility for organizing the Club's new permanent quarters in the Hotel Chatham.

M.I.T. Television Director

■ Appointment of Volta Torrey, former editor of *Popular Science Monthly,* as director of television for M.I.T., was announced recently by Francis E. Wylie, Director of Public Relations. Mr. Torrey will have charge of M.I.T. programs, such as "The Science Reporter," on WGBH-TV and other Institute activities in television, radio, and motion pictures.

Former president of the National Association of Science Writers and a member of the Aviation Writers Association, Mr. Torrey has written extensively for newspapers and magazines, has covered many events, such as the Bikini and Las Vegas atomic bomb tests, and helped prepare the report of the U.S. Strategic Bombing Survey. He has taught science writing and magazine editing at New York University.

A native of Eddyville, Iowa, Mr. Torrey is a graduate of the University of Nebraska and did graduate work at the University of Chicago. He was a Nieman fellow at Harvard University in 1939–1940.

Mr. Torrey served as assistant telegraph editor of the Chicago *Tribune,* night editor and Sunday editor of the Omaha *World-Tribune,* copyreader for the New York *Herald-Tribune,* news review editor of the Associated Press, and assistant managing editor of *PM.*

In 1945 Mr. Torrey went to *Popular Science* as an associate editor and became managing editor in 1946 and editor in 1951, serving in that capacity until recently. He has been a contributor to *Nation's Business, Physics Today, This week,* and other periodicals.

VISITING COMMITTEE REPORTS ON . . .

Mechanical Engineering

■ Members of the Visiting Committee on the Department of Mechanical Engineering* met on December 12, 1955, in the Edward F. Miller Room at the Institute with: James R. Killian, Jr., '26, President; Julius A. Stratton, '23, and Edward L. Cochrane, '20, Vice-presidents; C. Richard Soderberg, '20, Dean; and Professor Jacob P. Den Hartog. Unfortunately, Lewis K. Sillcox and Max L. Waterman, '13, were unable to attend this session which devoted its primary attention to the teaching and research activities in the field of power. During the morning session, members of the Committee heard presentations by members of the Department of Mechanical Engineering and visited laboratories.

Although Mechanical Engineering remains the second largest Department at M.I.T., freshman enrollment for the year 1955–1956 was down by 10 per cent, despite continuing urgent need for well-trained mechanical engineers. The Committee encourages efforts to increase undergraduate enrollment in the Department.

In discussing the curriculum for Course II, opinion appeared unanimous that the focus of the educational program should be on the needs several years hence

(*Continued on page 102*)

*Members of this Committee for 1955–56 were: Walter J. Beadle, '17, chairman; Redfield Proctor, '02, Max L. Waterman, '13, Charles A. Chayne, '19, George H. Burt, '20, Herbert G. Fales, '20, John F. Hennessy, '24, Jess H. Davis, Lewis K. Sillcox, and Glen B. Warren.

Metallurgy

■ Satisfaction with the Department's operations and objectives was expressed by members of the Visiting Committee on the Department of Metallurgy* who met at the Given Room in the Metals Processing Laboratory on December 6, 1955. Present at this meeting were: Irving W. Wilson, '11, chairman, Walter F. Munford, '23, Walter Crafts, '26, Charles B. Sawyer, '17, and George Roberts of the Committee, as well as Professors John Wulff, Morris Cohen, '33, Frederick H. Norton, '18, John T. Norton, '18, Antoine M. Gaudin, and John Chipman.

A review of the undergraduate curriculum was the major purpose of the meeting, and by way of preparation for this review, Professor Wulff discussed the necessity for attracting more students to Metallurgy. To accommodate such students, a flexible curriculum is required and one to which the student from other courses or colleges can transfer without major penalty or loss of time. It was pointed out that there might be a real danger of attracting a larger number of students than the Department is able to accommodate and that a modest increase to not more than double the present undergraduate enrollment would seem most desirable.

(*Continued on page 102*)

*Members of this Committee for 1955–1956 were: Irving W. Wilson, '11, chairman, Max L. Waterman, '13, Charles B. Sawyer, '17, Howard H. McClintic, '19, Walter F. Munford, '23, Walter Crafts, '26, Edgar C. Bain, Charles R. Cox, and George Roberts.

Soil Mechanics Lecturer

■ Karl Terzaghi, international authority on soil mechanics, has been appointed lecturer and research consultant in soil mechanics for the current academic year at the Institute, according to an announcement by C. Richard Soderberg, '20, Dean of the School of Engineering at M.I.T. In making this announcement, Dean Soderberg said:

"Dr. Terzaghi is one of the great pioneers in civil engineering, and although he will be at M.I.T. on a limited basis only, I am sure his presence here will be an inspiration to students and staff alike."

Professor emeritus of the practice of civil engineering at Harvard, Dr. Terzaghi is the founder of the modern science of soil mechanics, a field of great importance to foundation engineering. He is president of the International Conference on Soil Mechanics and Foundation Engineering.

Dr. Terzaghi previously taught at M.I.T. (from 1925–1929) as a special lecturer in soil mechanics, and as associate professor of foundation engineering. At M.I.T. he developed the first courses in soil mechanics to be given in the United States. Today soil mechanics has become basic to civil engineering.

Dr. Terzaghi has received numerous awards and prizes. These include three awards of the Norman Medal (American Society of Civil Engineers); the Desmond Fitzgerald Medal and the Clemens Herschel Award of the Boston Society of Civil Engineers; the Brown Medal of the Franklin Institute; and the New England Award of the Engineering Societies of New England.

Born in Prague, Czechoslovakia, on October 2, 1883, Dr. Terzaghi was graduated from the Technische Hochschule at Graz, Austria, in 1904, and in 1911, received a doctor's degree in civil engineering.

From 1906–1914, he was employed in various capacities on projects in Austria, the Balkans, and northern Russia. In 1912–1913, he traveled through the western part of the United States working on important projects of the U.S. Reclamation Bureau. After two years in the Austrian Army in World War I, he became professor of foundation engineering at the Turkish Engineering University.

In 1918, he transferred to Robert College in Istanbul as acting head of the Department of Civil Engineering. During the period from 1916-1924, he acted as consulting engineer on various difficult foundations and water supply projects. From 1925–1929, he was on the Faculty at M.I.T.

He then served as a professor at the Technische Hochschule in Vienna from 1929 to 1938. During these years he was a consultant on a hydroelectric development in northern Russia, various irrigation projects in Central Asia, on rock-fill dams in Algiers, and on numerous other structures in the Eastern Hemisphere.

Harvard University invited Dr. Terzaghi to lecture on soil mechanics in 1936. In 1938 he became a lecturer in the Harvard Graduate School of Engineering, and in 1947 was appointed professor of the practice of civil engineering. He has also served as lecturer and research consultant at the University of Illinois.

Wreck Brunswick Hotel

■ Technology Alumni who vividly remember "When M.I.T. Was 'Boston Tech'" will be interested to learn that the Brunswick Hotel is soon to be torn down to make room for a $4,000,000 office building at Boylston and Clarendon Street, in Boston. The Brunswick Hotel, built in 1874, was host to many celebrities, including Longfellow, Emerson, Mark Twain, and Presidents Grant, Cleveland, Arthur, and Garfield.

The Brunswick Hotel was opposite the original William Barton Rogers Building whose classrooms were first opened for use in February, 1866, although it was not until September, 1866, that the Rogers Building was in full use. The original Rogers Building was torn down in 1939 to make way for the office building of the New England Mutual Life Insurance Company.

Many Technology Alumni were well acquainted with the Brunswick Hotel, where chapel was held in earlier days of the Institute's history. In recent years the Brunswick had lost much of its former splendor. During World War II it was used by the U.S. Coast Guard as a receiving station.

To Study Structural Panels

■ Inauguration of a one-year study of structural sandwich panels, laminated components which are being used increasingly in building, is being undertaken by the Institute. The study has been made possible by a grant-in-aid from the Market Development Department of the Plastics Division of the Monsanto Chemical Company, which also supported a recent study at M.I.T. of the uses of plastics in building. An outgrowth of that program was a plastic house which Monsanto will erect at Disneyland.

Plastic sandwich panels will be used in this house, but sandwich panels of many types are now being manufactured and the purpose of the new study will be to compile information concerning their costs, characteristics and possible uses for the building industry. A sandwich panel is usually made of two thin strong faces and a low density core, which may be of plastic, plywood, metal, impregnated paper, or other materials.

A significant portion of the study will be devoted to the development and presentation of creative ideas for architectural applications. Richard W. Hamilton, '50, research associate in the M.I.T. Department of Architecture, who will be in charge of the study, commented on this new program as follows:

The lack of design and engineering information on sandwich panels for architects and designers is a serious gap in the literature of the building field. The characteristics of sandwich panels, such as strength, lightness, rigidity and uniformity, make them an increasingly important contender with the more traditional materials because of the shifting emphasis of construction to prefabrication. A wide variety of qualities in the basic materials enables a sandwich panel to meet many requirements but also presents new problems of design.

Manufacturers of sandwich panels will be invited to participate in the program in two ways: (1) by appearing in a series of conferences to be held at M.I.T.; and (2) by furnishing materials.

Treasurer's Annual Report

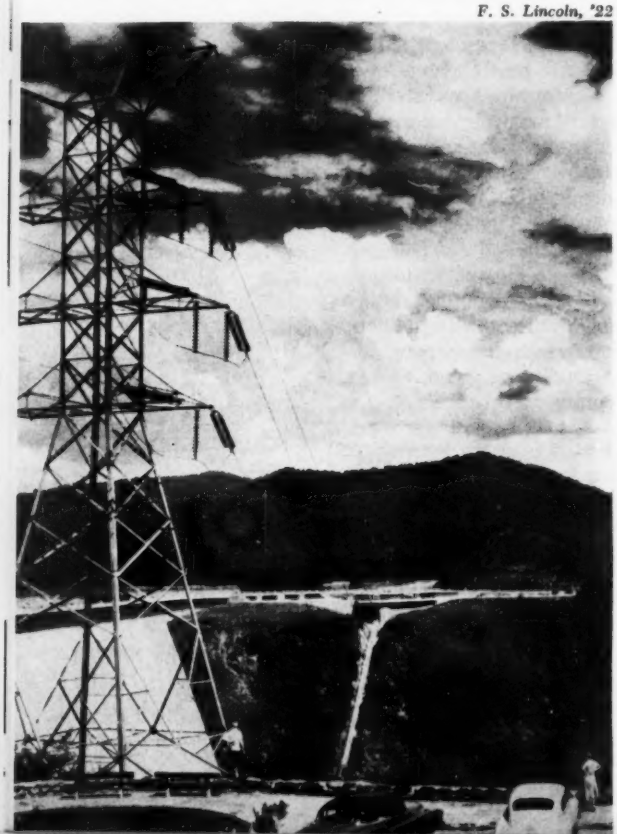
by JOSEPH J. SNYDER

In his report to the Corporation, Joseph J. Snyder, 2-44, Treasurer of the Institute, contrasted the academic operations at M.I.T. during the fiscal year ended June 30, 1956, by pointing out that the total operations were $17,099,000 as compared with $14,813,000 in the preceding year.

Academic expenses for the year under review reflected primarily increased Faculty salaries and compensation to Institute employees, along with increased departmental expenses for teaching and research. The increase in salaries and wages was met in part by a special distribution set aside a year ago from unallocated investment income. Gifts and other receipts and tuition income supplied a substantial proportion of the additional income required for the programs of the academic departments.

Sponsored research continued during the year as an important and growing responsibility of the Institute, and the financial volume of activity exceeded the level of the highest year during World War II. Many sponsored research projects are closely integrated with the teaching programs of the Departments and contribute very materially to academic operations, particularly to the strength of the Graduate School. A substantial proportion of the Institute's general administration, and plant operating expense is made up of indirect expenses of activities required by the sponsored research program.

F. S. Lincoln, '22



Gifts for the year exceeded the peak year during the great Development Program, with 1955-1956 at $10,387,000 compared to $9,145,000 in 1950-1951.

Gifts for endowment were higher than in any year since the end of World War II, with $1,360,000 received from the Ford Foundation for Faculty salaries. Endowment funds of $500,000 for research included $200,000 as an anonymous gift, and $300,000 from the estate of Edith Carson Wilder. Undergraduate scholarships were endowed with total gifts of $433,000. Principal donors were the estate of Katherine Noble; the family of W. Danforth Compton, '47, in his memory; Mrs. Marie G. Dennett for the Carl Pullen Dennett Fund; Godfrey L. Cabot, Inc., for the Cabot Endowed Scholarships; Paul W. Litchfield, '96, for the Litchfield Fund; Merrill, Lynch, Pierce, Fenner and Beane for the Charles E. Merrill Fund; Transoceanic Marine, Inc., for the Niarchos Merchant Seamen Memorial; Redfield Proctor, '02, for the Vermont Scholarships; and the Boston Stein Club for the New England Scholarships.

In the gifts received for buildings, major support to the Compton Laboratories and the nuclear reactor was provided by Irenee du Pont, '97, Mr. and Mrs. Alfred P. Sloan, Jr., '95, the Edwin Sibley Webster Foundation, the Rockefeller Foundation, and John L. Pratt. Alvan T. Fuller contributed generously toward the organ for the Kresge Auditorium.

Invested gifts for current use included the bequest of David F. du Pont, '56, of $1,006,000 for athletic facilities, the Alumni Fund of $355,000 and $220,000 from Alumni credited directly to specified purposes, and $430,000 as an expendable capital fund supplied by the Ford Foundation for professorships in economics.

The Sloan Foundation and the Ford Foundation made very large contributions for the continuation of programs financed by annual grants over a period of years.

During the fiscal year 1956 endowment funds increased from $48,056,000 to $51,084,000 and total funds increased from $73,833,000 to $82,679,000. Total endowment funds at the year end included as new endowment resources $1,692,000 for Faculty salaries, $660,000 for departments and research, and $433,000 for undergraduate scholarships. The increase of $3,028,000 for endowment contrasts with the increase of $5,818,000 in other funds, largely expendable for current purposes. Funds for additions to the academic plant, for student athletic programs, for the funding of Faculty tenure salaries and other expenses now met with current revenues, and for the support of the academic departments, together with

(Concluded on page 118)

M.I.T. Graduate Program at Oak Ridge

At the "campus away from campus" graduate students from many courses are attracted to a program of professional study dealing with peaceful applications of atomic energy

by ROBERT C. REID and J. EDWARD VIVIAN

NESTLED in the rolling, green hills of Tennessee, between the Great Smoky Mountains and the Cumberland Plateau, is Oak Ridge, one of the most famous research, development, and production areas under the authority of the Atomic Energy Commission. Although only 14 years old, this bustling, vital community plays an important role both in harnessing the atom for peaceful application and in supplying the atomic-weapon arsenal. It contains one of the highest concentrations of engineers and scientists in the South.

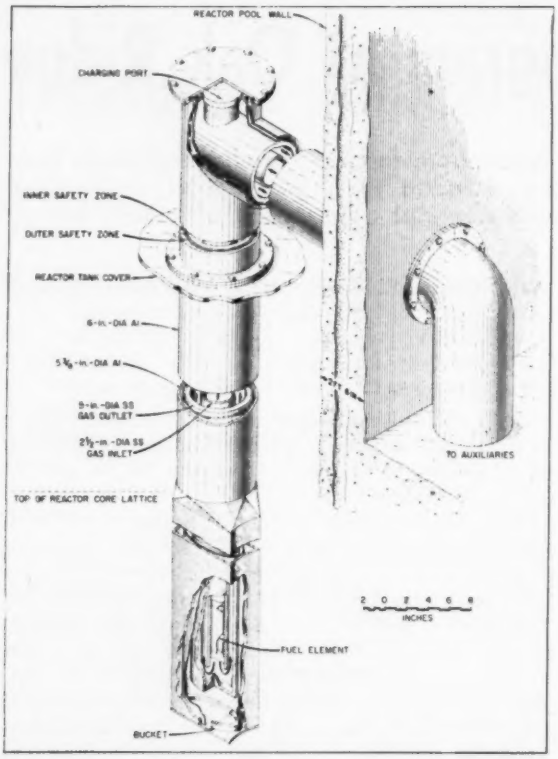
Recognizing the opportunities, both technical and financial, that would be afforded to graduate students by on-the-job learning and experience in the relatively new field of atomic energy, M.I.T. established the Engineering Practice School at Oak Ridge for its graduate students in 1948. In its eight years of operation, the School has become an integral part of the Oak Ridge industrial complex. Each year it graduates all types of scientists and engineers, most of whom will put their atomic "know-how" to work to further the basic and technological advances in this rapidly growing field. This "campus away from campus" entails, in the administrative sense, one semester, which is comprised of three courses in nuclear engineering, all of which are graduate courses with 16 units of credit per course.

Students attending the Practice School work in the three plant areas. The Gaseous Diffusion Plant, or K-25, produces uranium enriched in the fissionable isotope U^{235} by diffusion of a mixture of uranium-238 hexafluoride and uranium-235 hexafluoride through special tubular barriers. By the very nature of the process, the problems done at this plant have been unique. They have varied in scope from a statistical evaluation of barrier quality to chemical engineering production studies on uranium decontamination and recovery.

Very little can be said here concerning the student problems at the Y-12 Plant, since the nature of the operations is still highly classified.

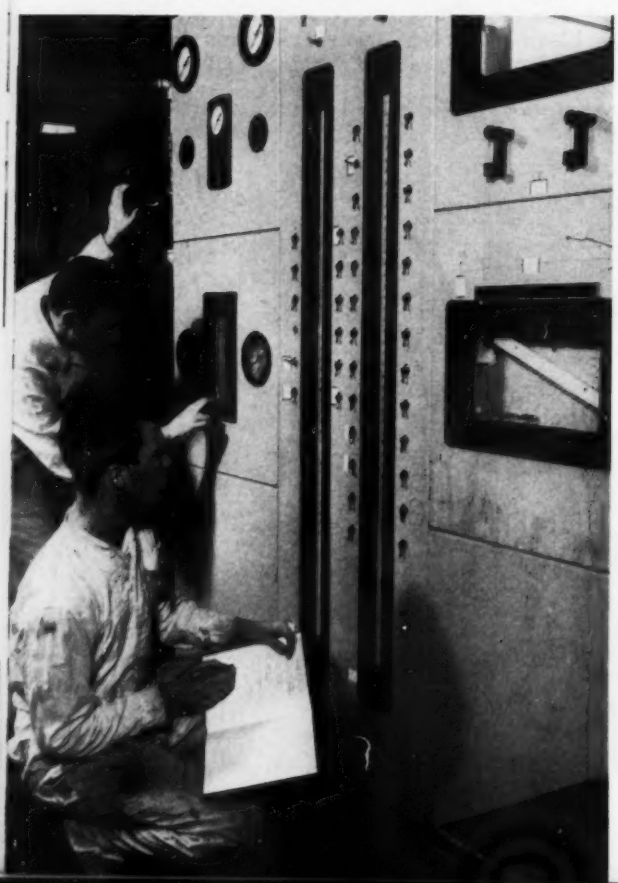
The Oak Ridge National Laboratory, or X-10, is primarily a research and development division and the Practice School has completed many excellent problems at this busy center. Physicists and nuclear engineers coming to the Practice School can look for-

Chemical engineers David H. Klipstein, '56, and Anthony J. Diglio, '55, are shown making experimental pressure drop measurements for gas-liquid, two-phase flow. The data taken here should be useful in the design of gas-let-down systems in homogeneous reactors' facilities.



▲ *This drawing shows a high-temperature, gas-cooled fuel-element test facility for the Oak Ridge reactor. This test loop was designed by four students for one two-week problem.*

▼ *Physicists Albert D. Rossin, '55, and Floro D. Miraldi, '53, are shown testing a novel leak system for mass spectrometers designed by Practice School students at Oak Ridge.*



ward to grappling with many problems in their field, as there are three reactors in operation and another under construction. In fact, a recent problem assignment dealt with drilling a four-inch core hole through the concrete shield of the O.R.N.L. graphite reactor. A typical problem in the Practice School program, it involved mechanical engineering aspects of core drilling, core testing, and data evaluation of concrete that has been under constant irradiation for over 10 years. For nuclear engineers, electrical engineers, and physicists it involved the challenging problems of measuring neutron spectrums and gamma rays after attenuation in concrete. The results of this study should aid in clarifying the theory of shielding in cubical reactors. In addition, facilities and problems are available at X-10 to metallurgists, ceramists, chemists, chemical engineers, and other technically trained personnel. The conclusion to be emphasized, however, is that, at Oak Ridge, the students meet and work with scientists and engineers of all types, from embryologists to sanitary engineers. No other field has required so many different scientific and engineering talents as atomic energy.

Education at the Practice School

The Oak Ridge Engineering Practice School has specialized in the unusual – unusual in the sense that the application of theory is new to most students. Every new problem – and new problems are assigned about every two to three weeks – is presented as a challenge to the ability of the student. By arousing students to meet these new challenges, the Practice School has stimulated creativeness and fostered the sense of achievement that accompanies the successful completion of any problem.

Practice School problems, suggested largely by the plant scientists and engineers, are assigned to groups of students only after it has been carefully ascertained that the problems will be educational and the results will be of value to the plant. A plant consultant is designated for every problem, so that although a student is directly responsible to the resident Practice School staff, he has direct liaison with the plant through the consultant, who has a real interest in seeing that the best job is accomplished in the least amount of time. When each group project is terminated, a report is prepared which is thoroughly checked and which is usually revised several times before the finished report is distributed to plant personnel. The knowledge that his signed report will be distributed to plant personnel for study, plus the considerable interest he takes in his work, encourages the student to his best efforts.

The opportunity to participate in solving some of the problems of concern to plant personnel motivates the student in accomplishing a great deal of good work in a surprisingly short time. This attitude provides the key to Practice School operations.

Union Carbide Nuclear Company, prime contractor to the Atomic Energy Commission in the Oak Ridge area, has subcontracted to M.I.T. for the establishment of the School and has provided the School with a medium-sized building which contains offices, classrooms, library, drafting room, and a fully equipped machine shop. An operating budget is provided to

As a recent problem, the Practice School, in conjunction ► with the Applied Physics Division of O.R.N.L., drilled a core hole through the concrete shield of the O.R.N.L. graphite reactor. Shown at the right is mechanical engineer, Dennis W. Vroom, '56, cleaning the core drill after one of the drillings.

maintain the station, to purchase necessary experimental equipment and office supplies, and, upon the recommendation of M.I.T., to pay each student $200 a month for the period during which he is enrolled at the School. The student is, therefore, an employee of Union Carbide Nuclear Company during his period of enrollment, and may participate in the company benefit plans for which he is eligible.

The enrollment at the Practice School is limited to 30, and a heterogeneous class is encouraged because many of the plant problems require teams of scientists and engineers with different backgrounds and training.

Even though the plant areas are closed to the public and travel from one plant or section of a plant to another requires a "need-to-know" priority, the students are granted a three-plant badge which puts them in the select group that may enter all three plants. This freedom is highly respected by M.I.T., and to date no security violations have been incurred. Although their interplant travel is confined to the need-to-know visits, in the one semester spent at the

▼ *Chemical engineers, James F. Nichols, '56, and Dean T. Morgan, a graduate student, are shown preparing uranium nitrate feed solutions for extraction efficiency experiments.*

School, the students will do problems in all three areas. Thus they will become acquainted with the operations in each area. In addition, they receive complete tours through almost all of the facilities in each area. The student who intends to stay with the expanding field of atomic energy is thus provided with an unexcelled opportunity to survey the atomic energy field.

Student Assignments

The students' work at the plant begins with an indoctrination into security, followed by introductory field trips to the three plants. The students are then split into groups and assigned problems. Since normally each problem will last from two to three weeks, in one semester some seven to eight different problems will be assigned to each student.

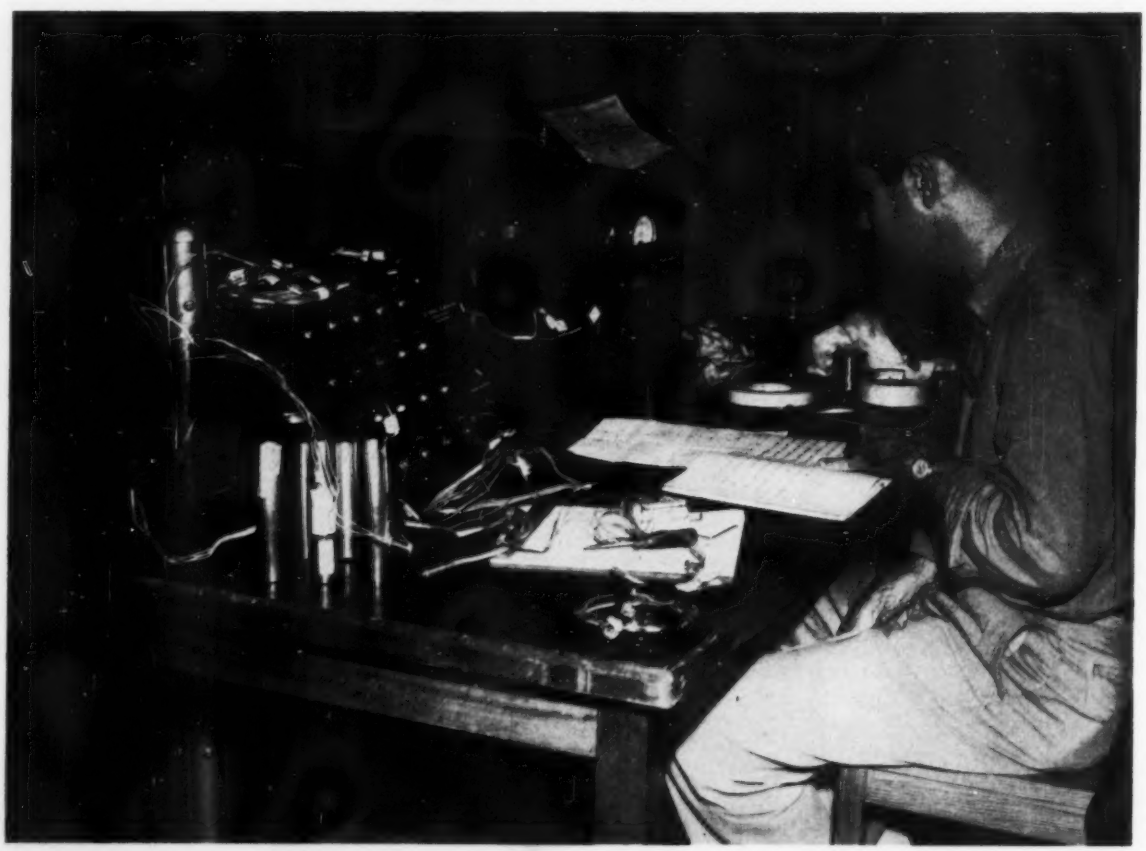
The selection and assignment of the problems are the responsibility of the Practice School staff. The selection of a problem is usually accomplished by conferences of the School staff with the plant men, and the request for a test or investigation frequently originates directly with the plant supervisors or laboratory heads. The assignments are always chosen with the approval of the superintendent whose division is most interested in the results to be obtained. The assignment is then presented to a section of the student group in the form of a memorandum outlining the general problem and the type of information desired. The size of the section and the time allotted vary with the magnitude and scope of the assignment; for example, two men may work on a limited research problem for one week, or 10 men may be engaged in a comprehensive design and development project for a month.

In no case is only one man assigned to a problem, for co-operative team effort is one of the factors stressed at the Practice School. In sections of three or more men, one man is appointed a group leader. He is responsible for co-ordinating the work and seeing that the assignment is completed on schedule. The responsibility of being a group leader is rotated among the men.

Each group has the responsibility for the solution of its assigned problem. The first step in the solution of the problem is to become acquainted with the existing theory, operations, and equipment involved. The group must then determine the phase of the problem to which the investigation will be confined. This may be accomplished by conferring with the plant men for their ideas and by consulting the literature, including plant reports, to determine what information is already available. Once the specific problem has been defined, it must be analyzed to determine the experimental data needed, the test

(*Continued on page 120*)

To aid in designing better equipment, mechanical engineer George W. Bond, Jr., a graduate student, is shown measuring radial and tangential strains while flexing a large bellows.



For Youths of Exceptional Promise

Memorial for Technology Alumnus established to offer encouragement to young men showing outstanding promise of a successful career in field of metallurgy

THE Robert Lansing Hardy gold medal has recently been established to recognize and encourage the professional development of young men in the early years of their careers. The award has been established to take note of young men of exceptional promise, rather than to acclaim achievement of persons already established in their respective fields of endeavor. With this objective in mind, the medal is to be awarded annually to a medalist who has not yet reached his 30th birthday before the end of the calendar year during which selection of the recipient is made. The American Institute of Mining, Metallurgical and Petroleum Engineers will administer this permanent award which is made possible by a fund which now amounts to $5,000.

In making the award in the field of metallurgy, the medal gives emphasis to a field of engineering in which Robert L. Hardy, '53, was especially interested and professionally active. By stipulating that the award be made to a young metallurgist of exceptional promise, the medal is intended to stimulate in others the personal characteristics of enthusiastic anticipation of a better life through professional attainments, for which Mr. Hardy was clearly and widely recognized when his career was prematurely ended.

The award is to be made by the American Institute of Mining, Metallurgical and Petroleum Engineers. Candidates for the medal are to be selected from those working in the broad field of metallurgy, including mineral beneficiation; extractive, physical, or adaptive metallurgy; and metal processing.

A principal objective of the award is to provide substantial encouragement to young professional workers, in their twenties, in the broad field of metallurgy, and to do so at a propitious time in their career. In keeping with this aim, it is planned that the award be announced in December of each year, and that the medal be awarded at a meeting of the local section of the American Institute of Mining, Metallurgical and Petroleum Engineers, with which the recipient is most closely identified. Nominations are to be submitted to the Awards Committee through the local section of the A.I.M.M.P.E.

The gold medal, one and three quarters inches in diameter, serves as a memorial to Robert Lansing Hardy, who was born in Wellesley, Mass., on November 22, 1929. After attending the Wellesley High School, he completed the Institute's Course in General Engineering. Upon receiving the S.B. degree in 1953, he then pursued graduate studies in the Department of Mechanical Engineering where he specialized in metallurgy and strength of materials. He received the S.M. degree from M.I.T. in 1954. While a student at the Institute, Mr. Hardy was a member of the Rifle Team. His broad interests were further reflected by the post he held as treasurer of *Voo Doo*, one of the Institute's student publications. He was a member of Sigma Xi, the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Society of Mechanical Engineers, and the American Society for Metals.

After receiving his master's degree, Mr. Hardy was employed as a metallurgist at the Watertown Arsenal, Watertown, Mass., and was quickly placed in charge of technical and business operations for several important projects dealing with national defense. Mr. Hardy was unusually well suited for his work at the Arsenal and made many friends during the few months he was privileged to engage in professional work. His work was prematurely brought to an end with his death on December 29, 1954, after an illness of several weeks. He was the only son of Professor and Mrs. Arthur C. Hardy, '18.

Lincoln Studio

Robert Lansing Hardy, '53
for whom gold medal is named

The Optical Probe—
A New Tool for the Blind

Using recently developed photocells and transistors, a pocket-size electronic device developed at M.I.T. is being subjected to extensive tests in the field

by CLIFFORD M. WITCHER

Just before his untimely death on October 6, 1956, Clifford M. Witcher completed manuscript for this Review article which now serves as a tribute to his important work in developing aids for the blind. Many of the devices conceived by Dr. Witcher require further development to make them available for the blind. It is hoped this aim can be achieved through establishment of a foundation dedicated to the application of science for the blind. – Ed.

For a long time, those interested in the development of aids for the blind have wished for a simple, compact photoelectric device—lightweight and inexpensive—that would enable a blind person to observe variations in light intensity. If such a device could be made sufficiently sensitive, it would make it possible for the blind user to "see" a number of useful things—the positions of pointers under glass, the position of printing or writing on paper, the heights of liquids in transparent vessels, and so on. Such a device has now been brought to a rather satisfactory state of development by the sensory aids project at the Institute's Research Laboratory of Electronics.*

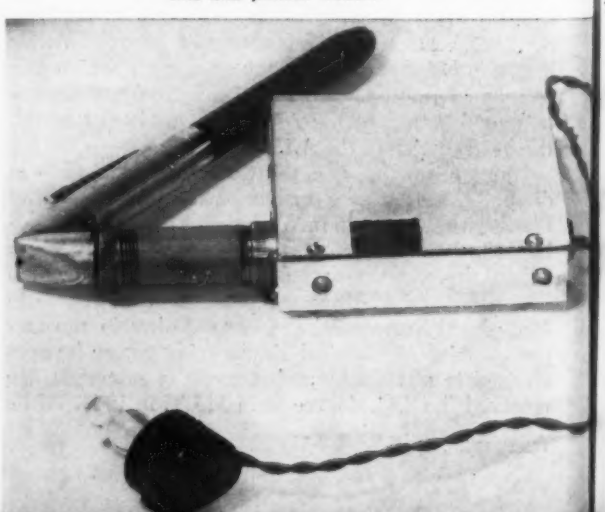
The American Foundation for the Blind, of New York City, provided funds for the production of 50 models of the instrument, and they were fabricated under the name Audi-Vis probe, by Dunn Engineering Associates, Inc., Cambridge, Mass. The Foundation plans to distribute them on a loan basis to blind people who have expressed a need for, or strong interest in, a device of this kind.

It was three years ago that the American Foundation for the Blind requested that the sensory aids group at the Research Laboratory of Electronics attempt to develop such a device. We did so: a photograph of the line and pointer locator, as the first model was called, is shown in Fig. 1. In this model, light from a small penlight entered one end of a v-shaped metal tube, as shown in the photograph. A part of the light reflected from any object held in front of the open vertex of the tube passed out of the other end, thence through a small lens, and finally fell on a small lead sulphide photocell.

The photocell served as the resistance element in a relaxation oscillator circuit that utilized a small neon glow lamp. The variations in resistance of the cell, caused by changing light intensity, were thus converted into variations in the frequency of the oscillator. A small hearing-aid type of earphone enabled the blind user to hear the frequency of the oscillator. To improve the sensitivity of the instrument, a second relaxation oscillator was provided, whose resistance element was a small hearing-aid type of potentiometer connected as a rheostat. By means of this rheostat, the second oscillator could be adjusted to synchronism with the first for any given light intensity. Thereafter, small changes in light intensity would produce readily detectable frequency differences between the two oscillators which produced audible sounds.

Two types of v-shaped tubes were provided. In the first type, the image of the photocell surface formed by the lens exactly coincided with the opening at the vertex. In the second, the image plane was approximately one-quarter inch out beyond the milled-off vertex of the tube. The first form served for detecting the position of printed or written material on paper, the procedure being simply to move the vertex of the tube over the surface of the paper. When the vertex opening passed over anything with less reflectivity than the paper (such as an ink line),

Fig. 1. First experimental model of the optical probe called the "line and pointer locator."



*This work was supported in part by the Army (Signal Corps), the Air Force (Office of Scientific Research, Air Research and Development Command), and the Navy (Office of Naval Research).

the frequency of the oscillator controlled by the photocell was lowered. The information provided by this type of device is not sufficient to make it possible to *identify* printed or written letters; but the ability to find the *position* of printing or writing on a page is of considerable use to blind typists.

The second tube, for which the image plane is one-quarter inch beyond the vertex, is well suited for the detection of pointers under glass. It thus makes it possible for the blind user to read meters, gauges, and so on, provided a transparent plastic scale (with raised markings) is laid over the face of the meter. The over-all weight of the instrument, including the penlight and the three 30-volt hearing-aid batteries needed to activate the oscillators, was approximately seven ounces.

About a year ago a new version of the device was constructed in which the lead sulphide photocell was replaced by a much more sensitive cadmium sulphide cell. With this cell the ratio of frequency change to change in light intensity was so much greater that the second relaxation oscillator could be dispensed with. In this model the auxiliary penlight was replaced by a small 1.5-volt incandescent lamp which was powered by a single penlight cell inside the case of the instrument.

It soon became apparent that the device was not only useful for the applications already mentioned, but that it also offered many more possibilities. By removing the lamp and the v tubes and focusing the lens for infinity, the instrument could be made to serve as a rather sensitive detector for distant light sources. Street lights were detectable at distances of 200-300 feet, and the moon could be detected with ease. By replacing the 0.5 inch lens with one of 2.5 inches in diameter, bright stars or bright groups of stars could be faintly detected. (The resolution of the instrument was about five degrees, so that, in general, one could not be sure whether the light from one or from several stars was responsible for the change in signal.) Of course, for low levels of light intensity, the signal heard by the user was not a continuous tone, but a series of clicks or pulses. In absolute darkness the resistance of cadmium sulphide cells may become of the order of 10^9 ohms, so that the signal pulses may cease altogether.

An interesting application of the instrument involving the detection of external light sources may be its use by a blind telephone switchboard operator. At present the telephone company can provide special equipment to enable a blind operator to identify the position of an incoming call; with the new optical probe it may be possible for her to locate directly the position of the signal light on the board. The American Foundation for the Blind has planned to conduct a study of this possibility. Still another application of the probe has been that of detecting the trace on a cathode-ray oscilloscope. For this purpose, a metal cone with a one-sixteenth inch opening at its vertex is placed over the front of the lens, and the optical probe is so adjusted that the image of the photocell is at the plane of the opening in the cone. With some practice, a blind person is able to get a fairly clear mental picture of any oscilloscope trace that can be held stationary.

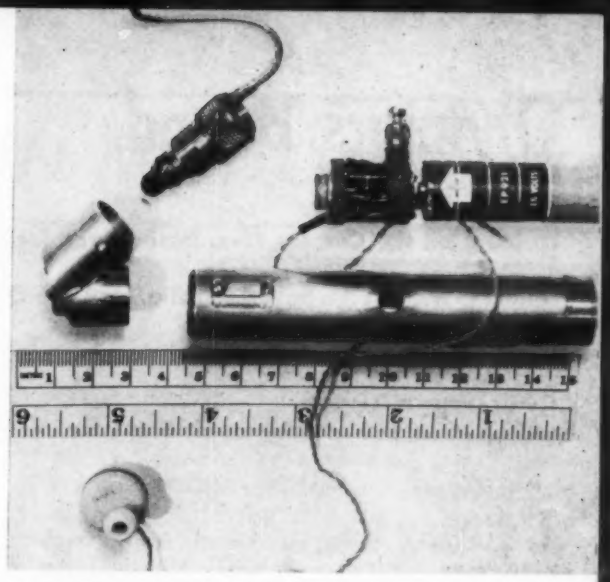


Fig. 2. Elements of the prototype model of the optical probe using transistors.

Early this year, Carl R. Hurtig, '51, of the Research Laboratory of Electronics, suggested that a transistor circuit might be devised to replace the previous relaxation oscillator, thus making possible replacement of three relatively bulky hearing-aid batteries by a single 1.5 volt penlight cell. The entire power supply consists of one small flashlight cell which is also used to provide power for the self-contained light source. In this circuit two low-noise junction transistors are arranged to operate as a free-running multivibrator oscillator. As in the case of the relaxation oscillator of the earlier model, the frequency of the multivibrator varies as a function of light intensity on the photocell. If the resistance of the cell varied inversely with light intensity, the multivibrator frequency would vary linearly with illumination. This is roughly true for low and medium light levels, but at high light levels

(*Continued on page 104*)

Fig. 3. Method of using the optical probe for obtaining readings of electrical indicating meter equipped with plastic plate having raised scale.

Olympics Bound

Training on the Charles River Basin leads Technology sailors to Melbourne Bay, Australia, for 1956 Olympics

by WALTER C. WOOD

To Australia, Olympics bound in November, were three graduates of M.I.T. athletic teams — former dinghy sailors, C. Eric Olsen, Jr., '39, and John Marvin, '49 — as well as First Lieutenant Herbert B. Voelcker, Jr., '51, U. S. Army, former Rifle Team captain, who was a member of the U. S. Olympic High Power Rifle Team.

Eric Olsen earned his qualifying berth in the Sharpie class, a two-man 18-foot sloop, a type not found in the United States but popular throughout Europe and Australia where the races will be held early this winter. The Sharpie class trials were held in Marion, Mass., where it was expected the prevailing strong winds would provide sailing conditions comparable to those in Melbourne Bay. Jolly boats, found in local waters, were used in the series, as they are the nearest boat akin to the Sharpie. At M.I.T., Olsen was one of the early enthusiasts who helped organize intercollegiate sailing and personally compiled an enviable record of championships as a member of the famous team of Olsen, Hanson, and Colie (C. Eric Olsen, Jr., '39, Herman H. Hanson, '39, Runyon Colie, Jr., '40) in the 1938–1940 era.

M.I.T. Photos

While a student at M.I.T., Olsen acted as junior instructor at the Pleon Yacht Club at Marblehead, and while there, developed a star sailor in John Marvin who later came to M.I.T. and sailed throughout his four years. Marvin will represent the United States in the single-handed or monotype class which will again be sailed in the Finn-class boats first used in the 1952 Olympics. The win was achieved only after two series of trials in Firefly dinghies at Marion, and then in borrowed Finn-class boats at Ottawa, Canada. In Ottawa first place was determined in an eight-race series only after a first-place tie was broken by Marvin who won over his competitor by four second places to two — both having equal point scores and the same number of first places. This will mark the third successive Olympic games in which the monotype representative from the United States has been a graduate of the M.I.T. Nautical Association. In 1948 Ralph L. Evans, Jr., '48, finished second, and in 1952 Edward A. Melaika, '53, participated in Helsinki.

Both Olsen and Marvin left San Francisco by air for Melbourne on November 6 for the races which started on November 22. Three other classes of boats participated in the Olympic races — the Star, the Dragon, and the 5.5.

John Marvin, '49, practicing in the Finn-class boat on the Charles River Basin in preparation for the Olympic races held on Melbourne Bay in late November. With toes anchored under straps in the cockpit, Marvin stretches the greater part of his body out over the side, with the tiller extension in one hand and the sheet in the other — a grueling attitude to be assumed over the greater part of the six-mile Olympic course.

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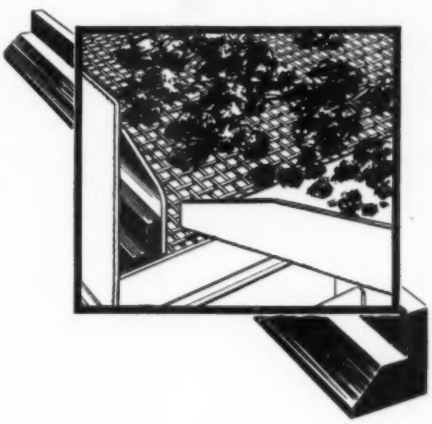

After discussing the problem with one of Revere's TA's (Technical Advisor), it was suggested that a Revere Copper Extruded Shape be used instead of the casting. It was furnished in 12 foot mill lengths. This offered flexibility and eliminated both welds and scrap. The extrusion licked the porosity problem, and its straightness was superior to the casting. Also it gave better longitudinal electrical contact. The cost per foot of the extrusion was more than the casting but the additional welds and scrap encountered made the final installed cost of the casting higher. In addition the finished extruded shape was superior. Another case where spending a little more initially resulted in an ultimate saving and a better product.

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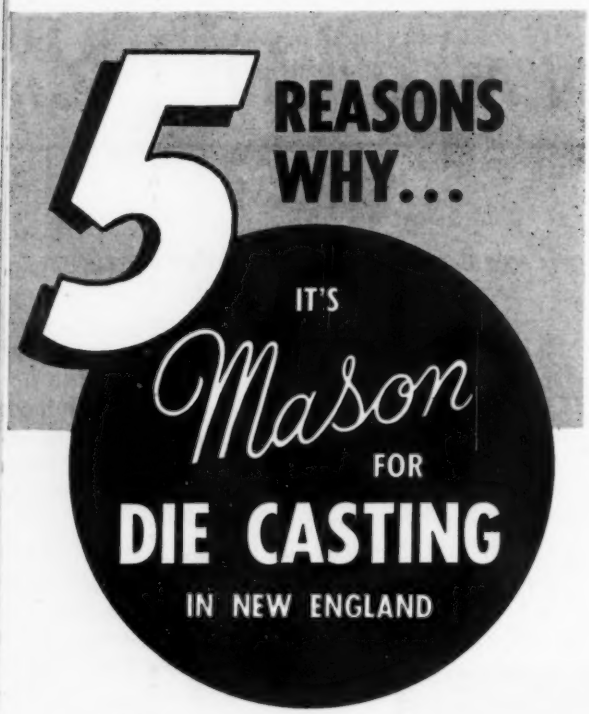

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TREND OF AFFAIRS

(*Continued from page 90*)

Visiting Committee Report—Mechanical Engineering

rather than on those of the immediate future. Moreover, science and technology are advancing so rapidly that the problems of this Department – and the teaching of science and engineering as a whole – are becoming increasingly difficult, so that continual review of the Department's changing needs is required. Some feeling was expressed that the field of propulsion was not being exploited to the extent that it should be to serve industry as well as the needs of the country. This situation results, in part, because of security restrictions imposed on some of the advanced technology in this field.

Some discussion related to the question of how best an institution like M.I.T. could co-operate with local industry in the advanced training of young engineers, with opportunity for obtaining advanced degrees. Many factors make such a program difficult to carry out with high quality, but the Committee felt that every effort should be made to make such a program effective.

Finally, the Committee recognized the need to continually seek the strongest possible staff, with proper inducements to the able younger men, and to synthesize and integrate the research and educational work to meet the changing needs, eliminating or reducing activities where possible to make room for the important new phases of mechanical engineering.

The Committee had no specific recommendations but urged that the Department continue to call attention of incoming students to the advantages and opportunities for men trained in the field of mechanical engineering, that it make every effort to remain in the vanguard in its educational and research programs by maintaining a first-quality staff and student body. The Committee agreed that Professor Den Hartog is not only well aware of the problems facing the Department but that he is working toward the proper solutions.

The Committee's report was considered at the March 5, 1956, meeting of the M.I.T. Corporation, and was received for publication in The Review on October 25, 1956.

Visiting Committee Report—Metallurgy

Professor Cohen submitted an outline of a proposed new curriculum which was presented for discussion and advice from the Visiting Committee. Three-fourths of the proposed curriculum is a core devoted to science and mechanics, metallurgy and humanities, while one-fourth consists of elective subjects that the student may select in Metallurgy and in other fields. If the core curriculum were to be adopted, more counseling than is now provided by registration officers would probably be necessary to help students plan an elective program with depth.

The general reaction of the Visiting Committee was to support the proposed curriculum but to point out

(*Concluded on page 104*)

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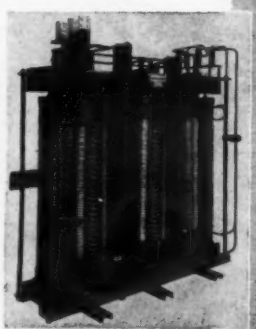

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TREND OF AFFAIRS

(*Concluded from page 102*)

that: (1) the quantitative viewpoint (such as that engendered by quantitative analysis) is to be preserved; (2) it is vital that the young metallurgist should have enough elective time in his curriculum to take a moderate amount of work in electrical engineering, and mechanical engineering, and (3) the engineering viewpoint must not be lost sight of in the new curriculum. The hope was expressed that the revised curriculum will give greater opportunities in the engineering direction.

Professor Chipman discussed the space requirements and facilities needed by the Department. He presented graphs which showed the steady increase in graduate enrollment and research activity and the simultaneous decrease in the amount of Institute funds used by the Department, despite the declining purchasing power of the dollar. The limiting factor in the research program at the present moment is space, and this is likely to remain the limiting factor until a new building or some other major space provision becomes available.

Among the physical needs of the Department were mentioned the following: (1) passenger elevator for Building 35; (2) air conditioning for the Building 35 lecture room; (3) dust-free air for laboratories in Buildings 4 and 8; (4) miscellaneous equipment, especially for metal working. The Committee strongly recommends that these physical needs be given understanding consideration by the Administration.

The meeting recessed at 12 o'clock for luncheon to which the entire staff of the Metallurgy Department was invited. At 2:00 P.M., the Committee met in executive session with C. Richard Soderberg, '20, Dean of the School of Engineering, and Professor Chipman. As a result of a thorough discussion of the personnel and policies of the Department, the Committee expressed its satisfaction in the Department's operations and objectives.

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THE OPTICAL PROBE

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the frequency variation is less. At very low light levels, the multivibrator will no longer operate when only 1.5 volts are applied to it. However, by applying three volts or more, the performance at low light levels becomes comparable with that of the relaxation oscillator circuit.

The current required for the multivibrator is very low, varying from 550 to 650 microamperes, depending on intensity of illumination, so that a useful battery life of a few hundred hours is achieved. Of course, for applications requiring the use of the internal light source (which requires 0.2 ampere), the battery life decreases to only a few hours. However,

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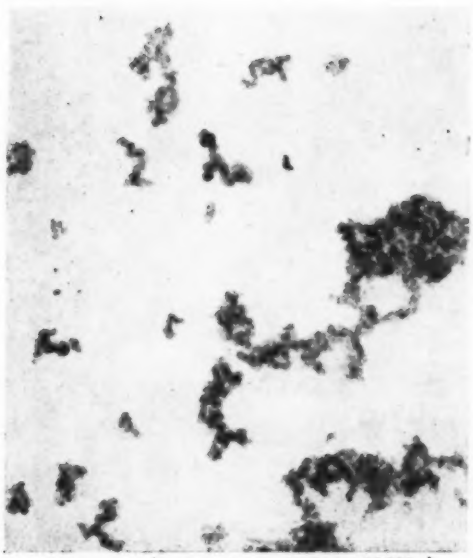
What is it?



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THE OPTICAL PROBE

(Concluded from page 104)

if the occasion arises in which it is necessary to use the probe with the light on for continuous work, an auxiliary power supply, such as a No. 6 dry cell, can readily be provided for the light.

An illustration of the various parts of the device, including one of the v tubes used for meter reading, is shown in Fig. 2. The way in which the device is actually used for reading a meter is illustrated in Fig. 3. A transparent plastic sheet, upon which a raised scale has been embossed, has been laid over the glass front of the meter so that scale indications can be determined by the sense of touch. Observe, also, the connection of the light to the small binding post on the side of the case of the optical probe. This binding post is the positive terminal of the battery. The other side of the light is grounded through the socket and v tube, and the negative side of the battery is grounded through the screw cap at the top of the instrument. The cap thus serves as a switch for both the light and the electronics circuits.

The cylindrical aluminum housing of the probe is four and five-eighths inches long and has an outside diameter of three-quarters inch. The weight of the probe and earphone, without light or v tube, is slightly under four ounces. Two v tubes are provided, as in the previous models, and also a cone with a small hole for observing small areas of different light intensity, such as oscilloscope traces, for example. A twist lock arrangement is used to secure these attachments to the probe, or to secure the lamp socket in either of the v tubes.

No doubt the field tests using the 50 models mentioned at the beginning of this article will lead to many new and useful applications of the instrument. Most especially, however, are we anxious to learn of applications of the optical probe that will lead to new employment opportunities for the blind.

In addition to serving as an aid for the blind, it would seem that an instrument of this type might be well suited for a number of other applications. Its light weight and compactness, together with its low power drain and reliability of performance, strongly suggest telemetric applications. In recent months, cadmium sulphide photocells with considerable sensitivity in the near infrared have been developed. With these cells, the probe might well serve as a useful component in infrared detection and communication systems.

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TREND OF AFFAIRS

(Continued from page 88)

Choral Society

The "Mozart All-Stars," as the M.I.T. singers were named by student members of the Darmstadt Orchestra (proud of their American lingo), gave six formal concerts: in Frankfurt, Weikersheim, Darmstadt, and Bad Mergentheim, and in the old university towns of Heidelberg and Marburg. The performances were an unqualified success. And even rehearsals drew a daily quota of German youngsters, who slipped into university music halls and medieval churches to listen – wide-eyed and silent – to the American visitors.

The concerts were conducted by Klaus Liepmann, Professor of Music at M.I.T. In addition to members of the Choral Society (freshman coeds and professors included), there were five soloists, all of whom were received enthusiastically at concerts and in the German press: Helen Boatwright, soprano; Margaret Tobias, alto; Donald Sullivan and David Ashton, tenors; and Paul Matthen, bass.

An unusual feature of the tour – and the one reported by Bill Burdine to be the most rewarding – was the musical accompaniment which was almost entirely provided by European student orchestras. That an American chorus should travel to Germany to sing, with German orchestras, several major choral works by German composers, was a signal honor and a signal experience.

The schedule of both groups was correspondingly hectic. Rehearsals were long and intensive, but there was time, too, for talk, less formal songfests, "seminars" (parties), dancing, picnics, and other get-togethers.

The Choral Society is the first American college group to have sung with the European Youth Orchestra and the Orchestra of Darmstadt Technical Institute, M.I.T.'s scientific counterpart in Germany. To Americans and Germans, the meeting was a particularly rich one, and the possibility of a repeat performance is already being discussed.

"It goes without saying," commented the *Oberhessische Zeitung* of an M.I.T.-Darmstadt Technical Institute performance, "that on such an occasion, the human contact between guests and their hosts is at least as important and taken as seriously as the musical event itself. Thus the enthusiastic applause in

(Continued on page 110)

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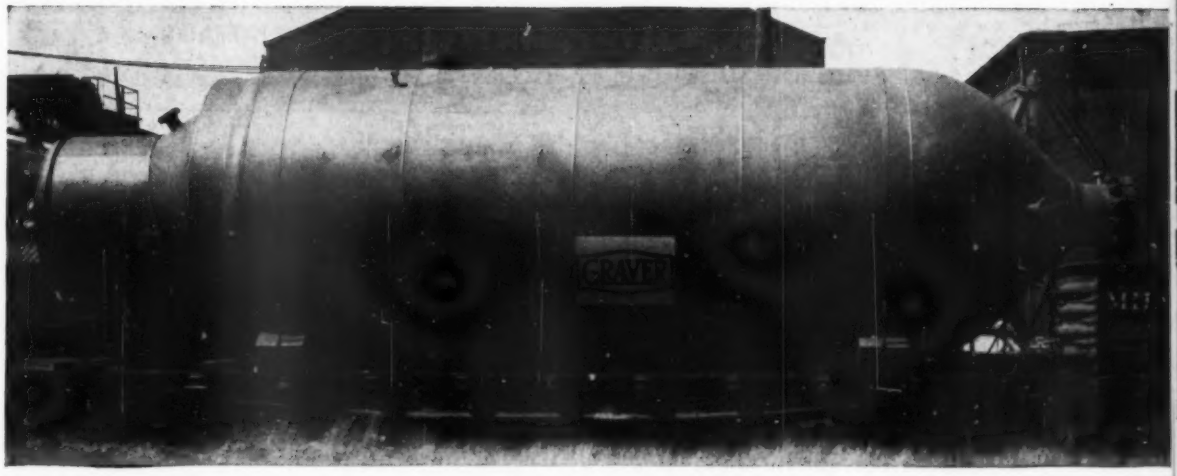

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TREND OF AFFAIRS

(Continued from page 108)

Choral Society

the overflowing auditorium expressed joy in this festive get-together of student youth, as well as thanks for their musical offerings."

M.I.T.'s musical offerings on the tour consisted of four major choral works: Haydn's "St. Teresa Mass," the Mozart "Requiem," Honegger's "King David," and Stravinsky's "Mass." (On one less formal occasion, they were called upon for the songs of Stephen Foster, and with the help of Paul Wild, elderly German actor-singer, joined their German friends in rousing Americo-German renditions of "Old Black Joe" and "Swanee River.")

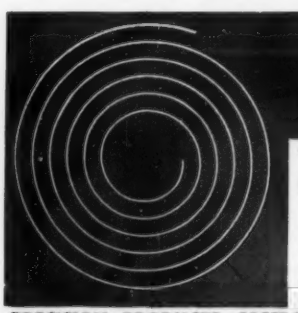
Musical contributions of M.I.T.'s German hosts ranged from Mozart's Jupiter Symphony to a trumpet fanfare written especially for the Choral Society's arrival in Weikersheim and played, like medieval heraldry, from the top of the church spire at the entrance to the ancient town.

Without exception, the response to the quality of music presented by the Choral Society and their German accompanists was favorable. Said the Darmstadt *Tageblatt*, "The (M.I.T.) chorus will dispel once and for all, many a European superiority complex! It is an amateur chorus, superbly balanced vocally, with strict discipline and clear diction, and absolutely sure in its entrances. We have the baton of Professor Klaus Liepmann to thank for the exemplary unity of this chorus."

Touching on the deeper meanings of the M.I.T.-Darmstadt Technical Institute music-making, the *Oberhessische Zeitung* noted: "The pieces that were performed were of an order of magnitude which points to a real musical avocation on the part of these groups . . . For it is not every day that a university chorus which is not made up of music students can prepare and perform one of the long Haydn Masses as the chorus from Cambridge did, and that a similarly nonprofessional university orchestra dares to attempt such a large symphonic task as Mozart's Jupiter Symphony, with some artistic justification, as did the future engineers from Darmstadt."

Yet, the tour did not begin and end with music alone. There were also personal highlights:

(Continued on page 112)



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TREND OF AFFAIRS

(*Continued from page 110*)

Choral Society

Dr. Karl Maguerre, Professor of Applied Mechanics at Darmstadt Technical Institute and conductor of the Darmstadt Technical Orchestra, almost adopted the Choral Society *in toto*. A brilliant scientist and accomplished musician who spent some years on the faculty of Washington University at St. Louis, Dr. Maguerre made his M.I.T. visitors feel immediately at home in their flying tour through a strange country. And, with loyalty supreme, he bicycled with his family from Darmstadt to Weikersheim – a distance of over 200 miles – to hear his M.I.T. friends sing there.

Also indispensable to the M.I.T. choristers was Gerd Miedel, son of Frau Dr. Hilde Miedel, who acted as liaison officer, general arranger, and interpreter. Frau Dr. Miedel, wife of a prominent German industrialist, was largely responsible for the tour, for she it was who first heard the Choral Society sing in this country and urged that they come to Germany last summer.

A Bostonian, Max Grossman, now Public Affairs Officer with the U.S. Information Agency in Frankfurt, saved the day more than once by co-ordinating housing arrangements for the group, as well as entertaining at a huge dinner in the Frankfurt Officers' Club.

A very special performance, audience-wise, was that of the Mozart Requiem in the Stadtkirchen at Weikersheim – an ancient church (1427) attached to Weikersheim Castle – at which Duke Gottfried, Duchess Margareta, and Prince Konstantin of Hohenlohe-Langenburg, owners of the castle, were present. The Hohenlohe-Langenburgs are members of a noble family which has its roots far back in German history; the Duchess is the sister of the Duke of Edinburgh. After the concert, the "royal" threesome gave a reception for Klaus Liepmann. Perhaps it was because of the distinguished company present that, according to Bill Burdine, this performance was the best.

For Professor Liepmann, the German tour had special significance: this was his first trip "home" since 1933, the year he came to the United States to continue a career, started in Germany, as professional violinist, conductor, and teacher.

"Where are you from, sir?" asked one German reporter after carefully listening to Professor Liepmann's fluent German. "Sounds to me as if you came from either Kiel or Hamburg." "Right," said Professor Liepmann, "I was born in Kiel and educated in Hamburg."

From castle tours to seminars, from banquets to solemn performances, from Stephen Foster to the exchange of technical notes on scientific developments in the two countries, the M.I.T. Choral Society tour in Germany was eminently successful. And most important of all were the many new friendships which were made with students across the seas.

(*Concluded on page 114*)

"Scrooge really has the Christmas spirit, Tiny Tim. This year he's packing 'em in H&D boxes."
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TREND OF AFFAIRS

(Concluded from page 112)

Choral Society

Bill Burdine sums it up this way: "For our American chorus and the German student orchestras to work together in a joint musical venture of this type was a wonderful demonstration of international goodwill and understanding, and seemed to all of us the essence of the entire effort."

Answers *Tauber Zeitung*, a newspaper covering the M.I.T.-European Youth Orchestra finale in Bad Mergentheim, "Something not so obvious (as the merit of the performance itself) was the spontaneous and enthusiastic joining of people from all areas through the medium of music, a language we all understand . . .; and the fact that a country of technical miracles and an Institute not specializing in art sends a nonprofessional choir which gave such an overwhelming performance. Perhaps from another country we, too, can learn that a rich life is not won by scientific and technical progress alone . . . Young musicians — in a real sense — do we thank for an enduring and impressive performance."

Security Officer Appointed

■ Appointment of Harvey Burstein as the Security Officer at the Institute has been announced by Edward L. Cochrane, '20, Vice-president for Industrial and Governmental Relations.

Mr. Burstein comes to M.I.T. with broad experience and thorough training in security work. He holds an LL.B. degree from Creighton University at Omaha, Neb., and served with the Federal Bureau of Investigation for six years before and after his war service. He had combat duty in the 9th Armored Division, and service in the Corps of Military Police of the United States Army. He has served as Chief, Division of Foreign and Domestic Investigations, Surveys, and Physical Security in the Department of State, and has recently been in private practice as a security consultant in Boston.

At M.I.T. he will be involved in the problems of security for the classified research work being done for the Federal government, and also with the general problems of plant protection which are extensive in an institution as large as M.I.T.

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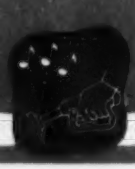

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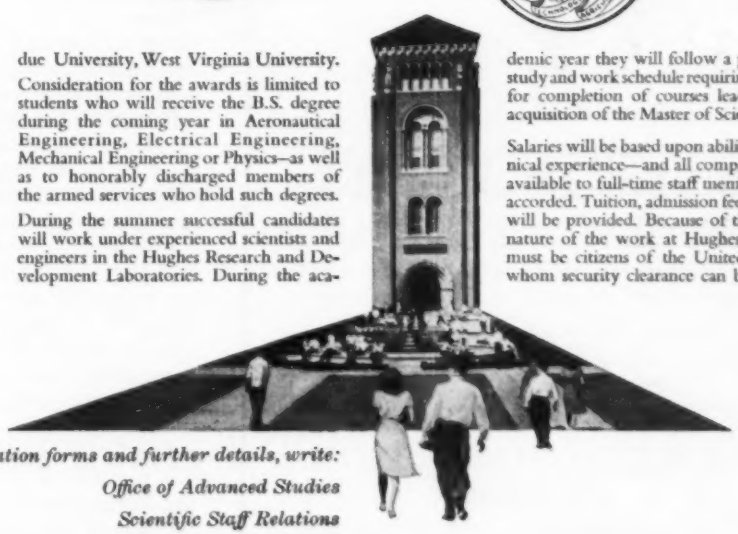

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TREND OF AFFAIRS

(Concluded from page 88)

Council Meeting

upon Technology's President, James R. Killian, Jr., '26, to report on recent developments that have taken place at the Institute.

Dr. Killian opened his remarks by mentioning the Institute's indebtedness to the Alumni Association and particularly to its officers. Then, turning to the topic of enrollment, Dr. Killian stated that currently there are exactly 6,000 students registered at M.I.T. The greatest increase is in the Graduate School. Actually, we do not yet have the anticipated tidal wave of applicants confronting the nation as a whole. In fact, the present pressure of college applicants is being felt only by the well-known institutions; many small schools have capacity available.

The Institute's attitude is that M.I.T. can do more to alleviate the shortage of quality than the shortage of numbers in the present need for larger numbers of well-trained engineers and scientists.

Speaking on scholarships, Dr. Killian reported that this year there was an 80 per cent increase in the available undergraduate scholarship funds, including $50,000 made available by the Alumni Fund. In addition, M.I.T. gains from the many national scholarships now available. For example, M.I.T.'s Freshman Class included 39 of the 550 recipients of the National Merit Scholarships. The Institute was second only to Harvard in the number of scholarships awarded by the National Merit, the General Motors Corporation, and the National Science Foundation. Clearly, Cambridge is receiving by all odds the largest share of these scholarship funds – a source of both embarrassment and pride. However, there is still much room for improvement as evidenced by the fact that there were 2,000 applications for scholarships by candidates for admission to the Freshman Class, yet only 275 of the 940 admitted to the Freshman Class were granted scholarship awards.

Enrolled in the 1956 Summer Session were 4,300 students. The regular routine undergraduate subjects are constantly decreasing in numbers and in enrollment. The number of programs for advanced professional work for persons currently employed is steadily increasing. This year there were 38 such special programs representing a total enrollment of 2,762 persons.

Finally, Dr. Killian reported that this fall, for the first time, M.I.T. has a Naval Reserve Officers' Training Corps Program. This is an experimental unit – the Navy's first. Only half of the normal N.R.O.T.C. Program consists of Reserve Training subjects. M.I.T. subjects have been subsituted in place of N.R.O.T.C. ones to make up the difference.

The final speaker of the evening was Victor F. Weisskopf, Professor of Physics, who spoke on his visit to the U.S.S.R. last summer. Dr. Weisskopf was one of a group of distinguished scientists who attended an international conference in Moscow dealing with subatomic particles of nature.

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TREASURER'S ANNUAL REPORT

(Concluded from page 92)

the net realized gain on investment transactions, composed the principal additions to other funds.

The construction of the nuclear reactor and reactor building was started in June, 1956. Further progress was made on the Karl Taylor Compton Laboratories, scheduled for completion and occupancy by the Departments of Physics and Electrical Engineering in the early part of 1957. The Computation Center, as a part of the Compton Building, is under construction and will be financed in part by the International Business Machines Corporation through grants made over a period of years. A grant of $500,000 received after the close of the year from the National Science Foundation assured the ultimate financing of the nuclear reactor and building, but other funds have yet to be secured to complete the project. The book value of the educational plant of the Institute was $37,980,000 on June 30, 1956, up from $36,086,000 on June 30, 1955.

During the fiscal year the general investments of the Institute increased from $71,831,000 to $79,390,000 at book value and during the same period the investments at market value from $109,344,000 to $123,683,000. Funds sharing in the income from the general investments earned 6.29 per cent on the average book value compared to 5.69 per cent last year, and 5 per cent was allocated to the funds compared to 4.5 per cent in 1954-1955 and 4.0 per cent in 1953-1954. In addition, 1 per cent was distributed in 1955-1956 from investment income earned in 1954-1955. The total income on the general and special investments was $4,070,000.

The financing of the Institute's operations illustrates its close relationship with the current problems of industry and government that provide valuable support for education at M.I.T. Well over half the Institute's current revenues for academic operations are provided by industry and government. After 15 years of heavy sponsored research responsibilities, the Institute's business operations, fiscal organization, and plant facilities have come to reflect the importance of the continuing support of industry and government. Private philanthropy is making an increasing contribution to the invested capital resources of the Institute for Faculty salaries, as is shown by the gifts received in 1955-1956; but unrestricted funds and income have been the principal sources of capital for funding salaries of the senior teaching staff during the past five years. Over that period the growth in general endowment and other capital funds for Faculty salaries has not kept pace with the increase in salary expenses, and yet Faculty salaries need to be further increased. The higher rate of investment income distributed on the funds of the Institute during the past two years has offset to some extent the deficiency in capital growth.

During the five years 1951 to 1956, the total assets at book value of the Institute have grown from $17,500 to $22,000 per student. This represents an average annual rate of growth in the order of 5 per cent, a very moderate rate in the light of the services the Institute is rendering the nation.

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PROGRAM AT OAK RIDGE

(*Continued from page 96*)

equipment required, the results expected, and the manner in which they will be presented.

The group then presents its plan of attack to the staff for approval. The staff make criticisms and suggestions, but as far as is possible the final decisions on the procedure are left to the students. After a procedure has been outlined, which is acceptable to both the students and the staff, it is taken for approval to the plant supervisor in whose division the work will be done. Following this approval, the necessary experimental equipment is built and the actual test is performed. Throughout, the importance of scheduling and the completion date are emphasized.

Problem Reporting

The assignment is complete when all the results have been analyzed and the conclusions and recommendations have been properly presented in a written account. The men get realistic experience in oral reporting during periodic sessions when short talks on these investigations are presented for the benefit of the plant personnel. An important part of these talks is the question period which follows, for it tests the speaker's grasp of his subject and his ability to give promptly a direct and adequate reply to a specific question. In addition to the talks on problem assignments, scheduled oral seminars are held throughout the term on assigned and optional subjects. These talks are recorded for the speaker to analyze and are freely criticized by the staff and students.

It is unfortunate, but true, that most graduate students write very poorly. But what is even more unfortunate is their unawareness of this handicap. An experiment in which the students themselves expose a poorly written report has been tried, with considerable success. After reports from the groups are turned in, they are given to other groups for editing. If the object is made clear to the students, they enter into the game with vigor, and each editing group sends the report back, almost completely covered with suggestions, criticisms, questions, and caustic wit. By such a technique each man is made aware of his limitations in coherent expression and begins to realize

(*Concluded on page 122*)

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PROGRAM AT OAK RIDGE

(Concluded from page 120)

that writing is an art in which clarity, conciseness, and accuracy are all highly important. In a recent survey of Practice School graduates, many students replied that the most valuable thing they learned at the School was the translation of thought and numbers into readable English.

Experimental problems are assigned in production, development, and research areas, and "paper" problems are employed to illustrate design techniques, modern methods of theoretical interpretation, and the vital importance of economic analyses. The accompanying illustrations show the variety of problems which are encountered.

Miscellaneous Activities

Other miscellaneous activities during the semester include trips to nearby industrial plants, dinners with Union Carbide Nuclear Company personnel as guests of the Practice School, and staff conferences. The staff conferences are somewhat unusual. Students rate each other, and plant consultants and staff rate the students. These ratings are coded and presented to the student during periodic conferences. The student thus has the opportunity to see himself as others do. The staff member who handles the conference may spend as much as an hour discussing the student's abilities and liabilities from a friendly point of view. Most students respond and react quickly to such a conference, for in most cases, it is the first time that such an honest evaluation has been presented.

Summary

The late Professor William H. Walker of M.I.T. stated that it is easier to acquire a knowledge of science than to apply intelligently and successfully such knowledge to the solution of practical problems. In recognition of this fact the primary objective of the Practice School is to develop the student's ability to apply fundamentals by assigning to him a variety of challenging plant problems. In other words, the Practice School strives to introduce the student to an industrial atmosphere. It also aims to develop in each student confidence in his ability to analyze and solve industrial problems and then to present his results in a written and oral form clearly, concisely, and accurately.

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—and the prophet replied:
"It is well to give when asked, but it is
better to give unasked, through understanding." *

Gifts by Will

TO THE
Massachusetts Institute of Technology

The tale is told of Almustafa, the prophet, who, having awaited for many years the ship that would return him to the place from whence he came, was making the final descent to the shore when the folk of Orphalese crowded about him. They besought him before departing to "disclose us to ourselves, and tell us all that has been shown you of that which is between birth and death."

With words of wisdom, an answer appropriate was given to the woman holding a babe, to the ploughman, to the merchant. Begged one, "Speak to us of GIVING," and the prophet replied:

> "It is well to give when asked, but it is better to give unasked, through understanding;
> And to the open-handed the search for one who shall receive is joy greater than giving. All you have shall some day be given;
> Therefore give now, that the season of giving may be yours and not your inheritors'."

Through the years the prophet's words have held true, for even today he who "through understanding" includes the MASSACHUSETTS INSTITUTE OF TECHNOLOGY as a beneficiary in his will can experience thereby a two-fold satisfaction. The successful culmination of his search for a worthy recipient and the anticipated results his generosity will assist in accomplishing. These satisfactions give an added value to the span of man's days and project his usefulness to his fellowmen far into the future.

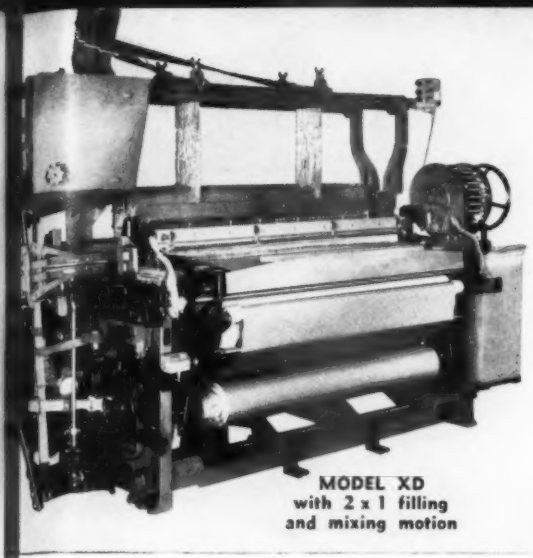
The Massachusetts Institute of Technology because of the high quality of the education given its students, its effective research work for aiding America in peace as well as in war, and the high character of its governing body and academic staff qualifies as an institution for serving our American ideals for the present and in the years to come.

But the search, the finding, and the anticipated accomplishments are not enough; for without the properly-worded record, man's plan for the future may go awry. Hence the prophet's importuning, "—give now," should be heeded. The giving need not be an immediate physical transaction, for written directions replace the spoken word when the speaker is no longer present, and a donor can frequently make by will a gift which is larger than he can make while living. Truly, *"it is well to give when asked, but it is better to give unasked, through understanding."*

A booklet "Gifts by Will," outlining different forms of bequests to M.I.T., is available to you or to your attorney by writing to:

Director of Development
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

* "The Prophet" by Kahlil Gibran



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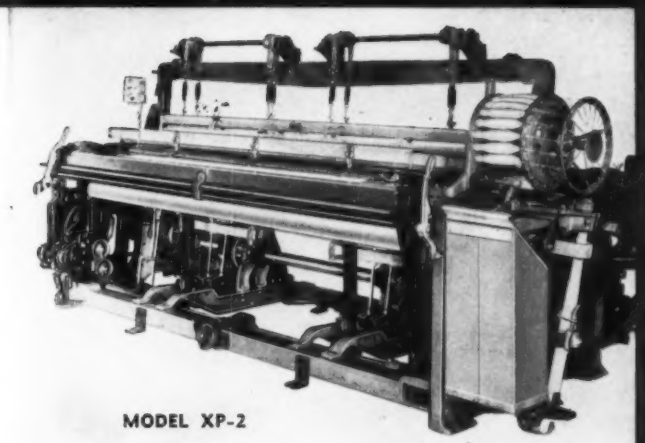

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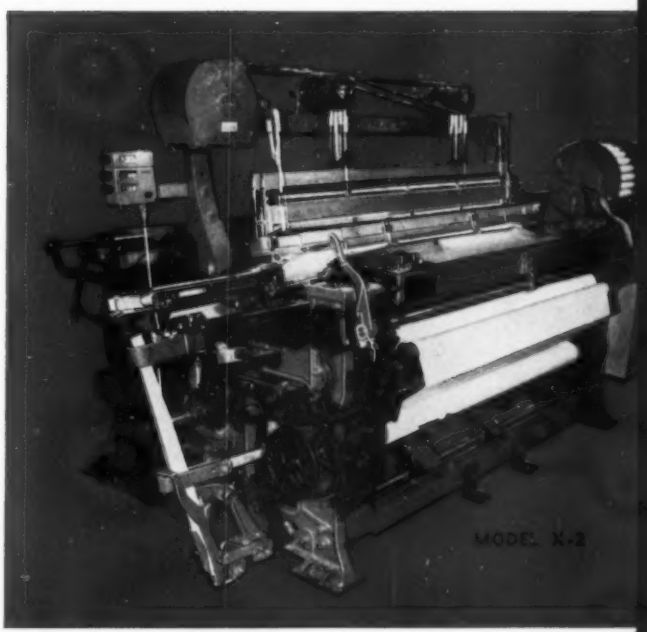

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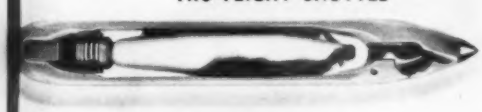

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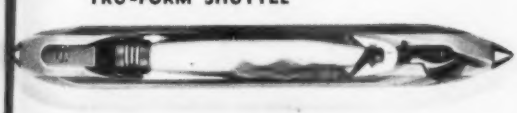

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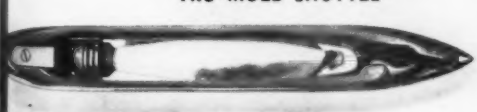

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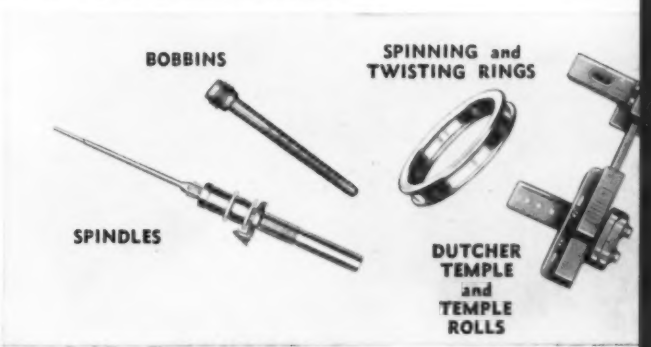

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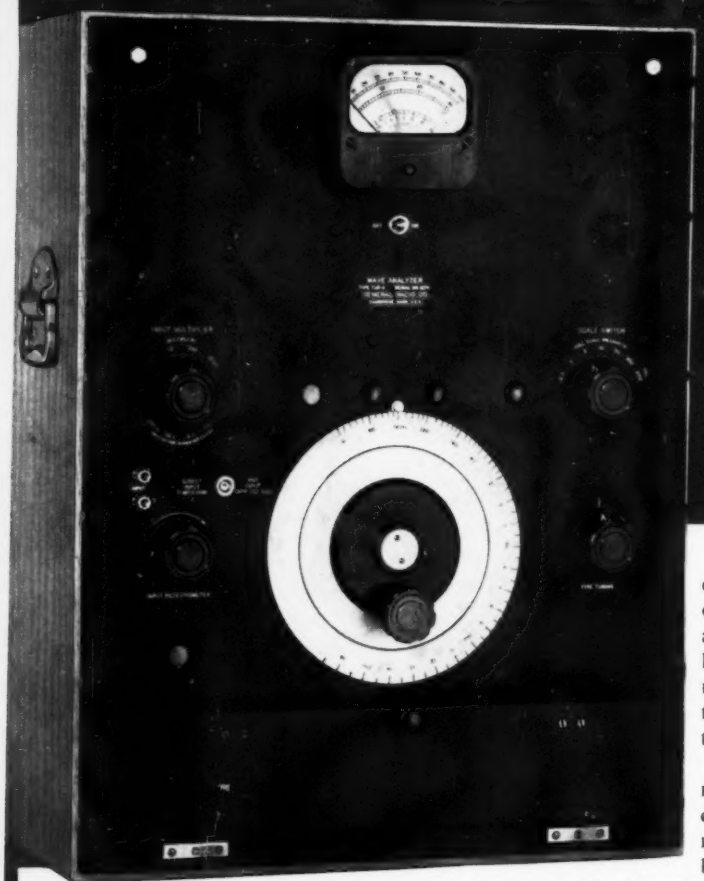

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The Wave Analyzer is ideally suited for measurements on all kinds of audio-frequency equipment, oscillators, amplifiers, telephone and public address systems, broadcast receivers and transmitters and other vacuum-tube circuits. Noise and hum measurements and analyses are also possible. As a sharply tuned voltmeter, the Wave Analyzer is invaluable in the measurement of the transmission characteristics of electrical wave filters. In addition, it has wide application outside the electronics laboratory, as in the determination of harmonics of electrical power systems and electrical machinery.

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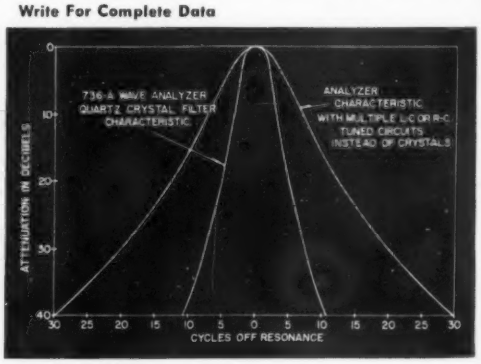
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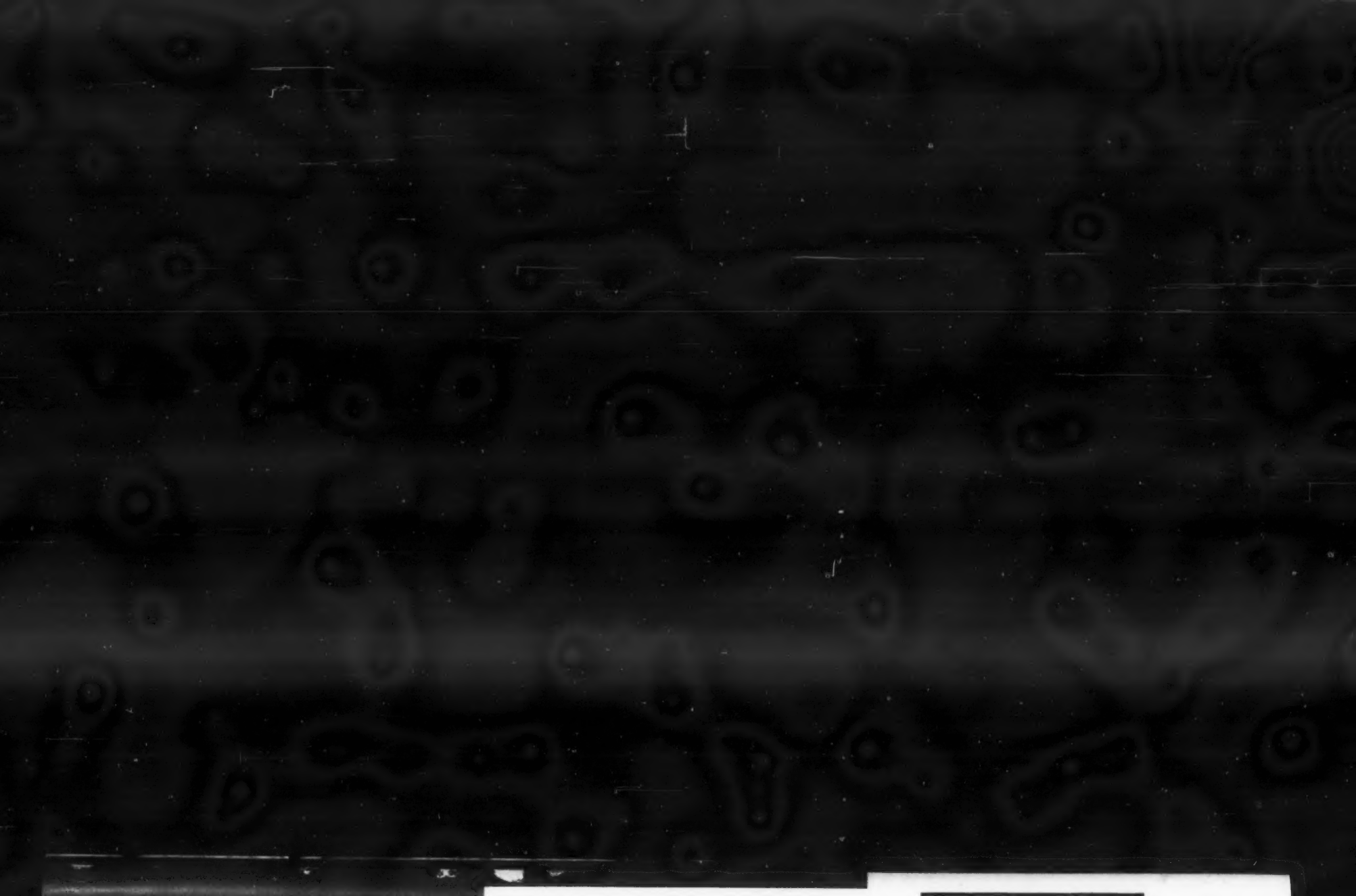
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